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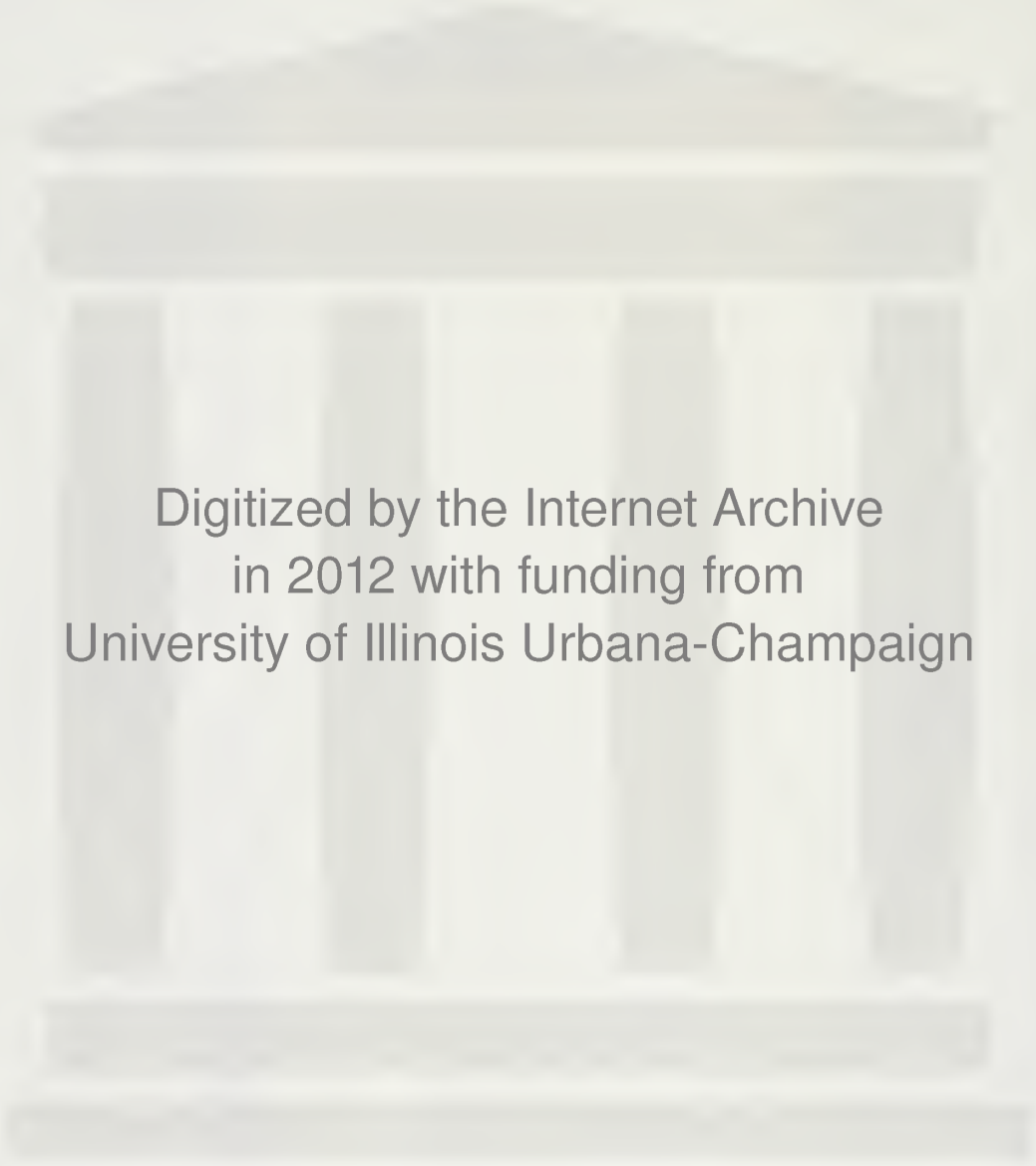
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U.S. ENERGY AND FUEL DEMAND TO 1985: A COMPOSITE PROJECTION BY USER WITHIN PAD DISTRICTS

by

Michael Rieber
and
Ronald Halcrow

Revised May 1974

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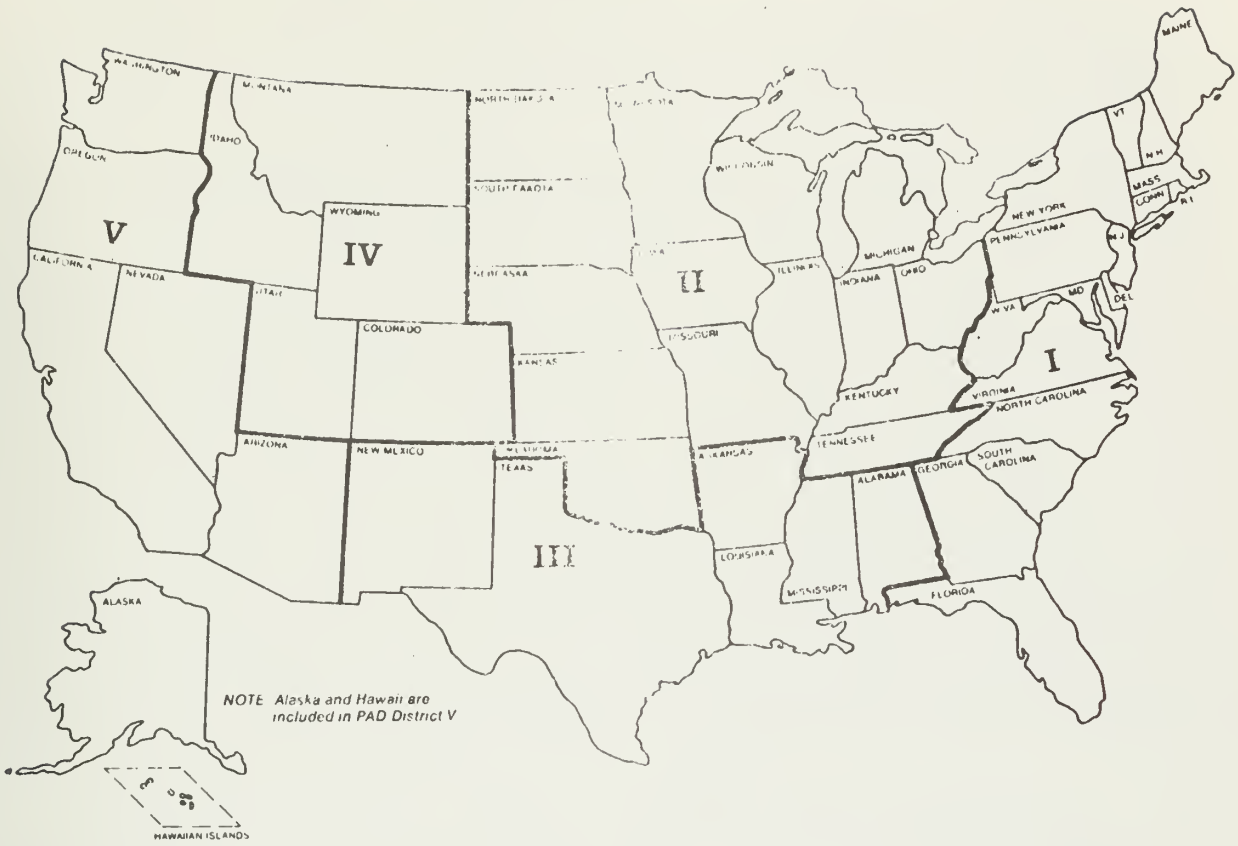
Petroleum Administration for Defense (PAD) Districts



Census Divisions

INTRODUCTION

A number of energy demand forecasts or projections have been made during the past few years. Surveys of earlier demand projections have been made by the Battelle Memorial Institute[1] and the Senate Committee on Interior and Insular Affairs.[2] In general, it has been found that the forecasts understated total energy demand, were outdated for current needs, or were of limited scope. It was felt that to be useful for current planning, a forecast must cover a time horizon which includes the relevant planning period while excluding purely speculative estimates, include the major fuels and their subdivisions, divide consumers into at least major market sectors, and be on a geographic basis that is compatible with that used by governmental planning agencies. The present study spans the period from 1970-1985. Consumer groups are divided into residential/commercial, industrial, transport, electric utility and nonenergy sectors. The energy demand of each of these groups are evaluated for each of the five PAD districts. Demand is stated in both BTU's and fuel units with respect to petroleum and petroleum products, coal, natural gas, nuclear power and hydropower.

The present study is a composite projection based primarily on data obtained from four recent projections. These include the Federal Power Commission (FPC), National Petroleum Council (NPC), Bureau of Mines (BOM), and the National Economic Research Associates, Inc., (EEI).[3] None of these studies made explicit demand estimates for specific fuels used by each class of consumer in each PAD district. Furthermore, there are differences among them due to differences in forecasting assumptions and data bases. Comparisons among these projections are reviewed in Appendices C, D and E of this study.

Economic activity (GNP), the cost of energy, population and environmental controls were among the parameters of energy demand, considered most important in the forecasts studied. However, the direction, focus and coverage differed among the forecasts. The NPC and BOM forecasts included all energy markets, while the FPC and EEI forecasts included only the utility market. Although all groups produced similar total electric utility forecasts, they differed in the fuel mix implied by these forecasts. Natural gas demand estimates made by the FPC, NPC and EEI were derived from forecasts made by the Future Requirements Committee (FRC).[4]

The FPC altered the FRC estimates by restricting natural gas demand to expected supply, i.e. a supply forecast. The BOM forecasted natural gas demand independently, but also restricted demand to projected supply. In the electric utility market, different assumptions concerning natural gas demand caused the NPC to project relatively high petroleum and natural gas demand. The EEI estimates produced low petroleum and coal forecasts. The FPC and BOM forecasts were between those of the NPC and EEI. In the present study, it was decided to project demand strictly. Thus, the present natural gas demand estimates in the electric utility market are equal to the forecasts made by the FRC. Alternate fuels were then adjusted accordingly.

When based on projections of total energy consumption on a BTU basis, the projection of energy consumption in terms of the consumption of specific fuels depends on the fuel mix assumed. Each of the projections studied involved different fuel consumption mixes. In this paper, energy demand has been reevaluated by market, fuel source and PAD district, given a specific set of assumptions. The forecast is presented in Tables I and IA. Table I is expressed in fuel units, Table IA is expressed in BTU's. Table I was derived from Table IA by using BOM and NPC conversion factors on the basis of the weighted average of the demand for fuel products within each market and each PAD district. The specific procedure used for determining the fuel with mix is shown in Appendix A.

The present forecast is based on the NPC estimate of total energy demand, in BTU's, for the period 1970-1985. The major assumptions made in that forecast are presented in Appendix B. It should be noted that the NPC demand forecasts were derived by individual Task Groups. A simple summation of the individual fuel demands made by these groups does not equal NPC totals. These differences were reconciled by the NPC Coordinating Committee. In general, this study disregards these reconciliations. Differences occur between the results of this study and that of the NPC because of the treatment of the reconciliations, the use of certain alternative fuel projections and differences in consumer and/or regional coverage.

TABLE I

U.S. Energy Demand Projection
by Major Consuming Sector
and PAD District - 1970

(Fuel Units)

	Petroleum (10^6 B/Yr)	Coal (10^6 T/Yr)	Natural Gas (10^9 CF/Yr)	Nuclear (MW(e))	Hydro (BKWH)
PAD District I					
Residential/Commercial	550	2.9	1800		
Industrial	177	27.5	1284		
Transportation	1024		65		
Electric Utility	286	111.3	505	4182	44.2
Non-Energy	106	1.9	117		
Total	2143	143.6	3771		
PAD District II					
Residential/Commercial	279	10.9	3197		
Industrial	155	50.0	2478		
Transportation	929	-	252		
Electric Utility	14	177.3	971	2226	30.1
Non-Energy	124	3.4	190		
Total	1501	241.6	7088		
PAD District III					
Residential/Commercial	56	.1	734		
Industrial	117	2.3	4140		
Transportation	364	-	305		
Electric Utility	1	22.3	1617	-	10.8
Non-Energy	289	.1	403		
Total	827	24.8	7199		
PAD District IV					
Residential/Commercial	20	.8	260		
Industrial	21	1.5	238		
Transportation	90	-	10		
Electric Utility	2	8.0	63	-	19.0
Non-Energy	15	.1	2		
Total	143	10.4	573		
PAD District V					
Residential/Commercial	46	.2	910		
Industrial	79	.3	897		
Transportation	502	-	57		
Electric Utility	29	.9	759	499	144.9
Non-Energy	49	-	54		
Total	705	1.4	2677		
U.S. Total	5324	421.8	21308	6907	249

Sources are listed at end of table.

TABLE I cont.

U.S. Energy Demand Projection
by Major Consuming Sector
and PAD District - 1975

(Fuel Units)

	Petroleum (10^6 B/Yr)	Coal (10^6 T/Yr)	Natural Gas (10^9 CF/Yr)	Nuclear (MW(e))	Hydro (BKWH)
PAD District I					
Residential/Commercial	597	2.9	2260		
Industrial	218	21.2	2071		
Transportation	1249		88		
Electric Utility	615	77.4	566	30564	46.0
Non-Energy	129	1.5	168		
Total	2808	103.0	5153		
PAD District II					
Residential/Commercial	332	7.0	3896		
Industrial	190	55.0	3699		
Transportation	1104	-	342		
Electric Utility	41	252.2	1448	17856	30.1
Non-Energy	159	3.7	242		
Total	1826	317.9	9627		
PAD District III					
Residential/Commercial	85	.2	848		
Industrial	132	4.2	5284		
Transportation	435	-	393		
Electric Utility	28	26.1	2298	4869	12.5
Non-Energy	395	.3	595		
Total	1075	30.8	9418		
PAD District IV					
Residential/Commercial	24	1.2	310		
Industrial	28	2.5	298		
Transportation	109	-	12		
Electric Utility	8	10.8	83	330	25.0
Non-Energy	18	.2	-		
Total	187	14.7	703		
PAD District V					
Residential/Commercial	58	.4	1125		
Industrial	103	1.7	1289		
Transportation	643	-	74		
Electric Utility	132	3.3	1068	4661	157.4
Non-Energy	64	.1	38		
Total	1000	5.5	3594		
U.S. Total	6896	471.9	28495	58280	271

Sources are listed at end of table.

TABLE I cont.

U.S. Energy Demand Projection
by Major Consuming Sector
and PAD District - 1980

(Fuel Units)

	Petroleum (10^6 B/Yr)	Coal (10^6 T/Yr)	Natural Gas (10^9 CF/Yr)	Nuclear (MW(e))	Hydro (BKWH)
PAD District I					
Residential/Commercial	623	2.7	2723		
Industrial	274	21.2	2666		
Transportation	1491	-	107		
Electric Utility	973	54.2	592	51318	48.5
Non-Energy	175	1.5	105		
Total	3536	79.6	6193		
PAD District II					
Residential/Commercial	355	6.4	4597		
Industrial	237	55.0	4673		
Transportation	1315	-	411		
Electric Utility	74	284.5	1655	30268	29.3
Non-Energy	196	3.7	326		
Total	2177	349.6	11662		
PAD District III					
Residential/Commercial	95	.2	1011		
Industrial	156	4.2	6038		
Transportation	517	-	465		
Electric Utility	115	30.5	2965	7828	15.0
Non-Energy	502	.3	942		
Total	1385	35.2	11421		
PAD District IV					
Residential/Commercial	27	1.1	349		
Industrial	36	2.5	327		
Transportation	131	-	14		
Electric Utility	32	12.6	95	330	31.3
Non-Energy	21	.2	-		
Total	247	16.4	785		
PAD District V					
Residential/Commercial	63	.3	1327		
Industrial	121	1.7	1457		
Transportation	784	-	80		
Electric Utility	351	1.3	885	10300	171.9
Non-Energy	79	.1	29		
Total	1398	3.4	3778		
U.S. Total	8743	484.2	33839	100044	296

Sources are listed at end of table.

TABLE I cont.

U.S. Energy Demand Projection
by Major Consuming Sector
and PAD District - 1985

(Fuel Units)

	Petroleum (10^6 B/Yr)	Coal (10^6 T/Yr)	Natural Gas (10^9 CF/Yr)	Nuclear (MW(e))	Hydro (BKWH)
PAD District I					
Residential/Commercial	647	.9	3242		
Industrial	337	21.2	3340		
Transportation	1761	-	130		
Electric Utility	1327	61.9	682	80000	50.0
Non-Energy	227	1.5	291		
Total	4299	85.5	7685		
PAD District II					
Residential/Commercial	395	2.1	5403		
Industrial	276	55.0	5606		
Transportation	1539	-	480		
Electric Utility	278	304.9	1793	50000	30.0
Non-Energy	238	3.7	575		
Total	2726	365.7	13857		
PAD District III					
Residential/Commercial	116	.1	1182		
Industrial	239	4.2	6872		
Transportation	606	-	551		
Electric Utility	184	39.8	3852	14000	15.5
Non-Energy	634	.3	1416		
Total	1779	44.4	13873		
PAD District IV					
Residential/Commercial	43	.4	394		
Industrial	44	2.5	361		
Transportation	162	-	16		
Electric Utility	55	15.5	116	1000	38.0
Non-Energy	25	.2	1		
Total	329	18.0	888		
PAD District V					
Residential/Commercial	71	.1	1548		
Industrial	142	1.7	1626		
Transportation	950	-	87		
Electric Utility	589	-	829	20000	182.5
Non-Energy	97	.1	55		
Total	1849	1.9	4145		
U.S. Total	10982	516.1	40448	165000	316

Sources are listed at end of table.

TABLE I cont.

Sources:	Natural gas:	Table A3-I
	Coal:	Table A2-I
	Petroleum:	Table A1-I
	Nuclear:	Table II
	Hydro:	NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 184.

TABLE IA

U. S. Primary Energy Demand Projection
by Consuming Sector and PAD District
1970

(10^{12} BTU's)

	Sector	Petroleum	Coal	Natural Gas	Nuclear	Hydro	Total
PAD District I							
	Residential/Commercial	3207	76	1800			5083
	Industrial	1066	715	1284			3065
	Transportation	5487	-	65			5552
	Electric Utilities	1793	2670	521	147	475	5606
	Non-Energy	616	50	121			787
	Total	12169	3511	3791	147	475	20093
PAD District II							
	Residential/Commercial	1471	290	3197			4958
	Industrial	905	1300	2478			4683
	Transportation	4926	-	252			5178
	Electric Utilities	90	3897	1002	32	324	5345
	Non-Energy	735	92	196			1023
	Total	8127	5579	7125	32	324	21187
PAD District III							
	Residential/Commercial	248	3	734			985
	Industrial	687	60	4140			4887
	Transportation	1926	-	305			2231
	Electric Utilities	10	490	1669	-	116	2285
	Non-Energy	1386	4	416			1806
	Total	4257	557	7264	-	116	12194
PAD District IV							
	Residential/Commercial	105	20	260			385
	Industrial	123	39	238			400
	Transportation	478	-	10			488
	Electric Utilities	13	150	65	-	204	432
	Non-Energy	96	3	2			101
	Total	815	212	575	-	204	1806
PAD District V							
	Residential/Commercial	252	6	910			1168
	Industrial	471	8	897			1376
	Transportation	2776	-	57			2833
	Electric Utilities	182	23	783	63	1558	2599
	Non-Energy	286	1	54			341
	Total	3967	38	2701	63	1558	8317
	U.S. Total	29335	9897	21456	242	2677	63597

Sources listed at end of table.

TABLE IA cont.

U. S. Primary Energy Demand Projection
by Consuming Sector and PAD District
1975

(10^{12} BTU's)

	Sector	Petroleum	Coal	Natural Gas	Nuclear	Hydro	Total
PAD District I							
	Residential/Commercial	3470	81	2260			5811
	Industrial	1314	550	2071			3935
	Transportation	6720		88			6808
	Electric Utilities	3842	1750	584	1293	482	7951
	Non-Energy	742	40	173			955
	Total	16088	2421	5176	1293	482	25460
PAD District II							
	Residential/Commercial	1729	195	3896			5820
	Industrial	1111	1430	3699			6240
	Transportation	5888		342			6230
	Electric Utilities	253	5700	1493	823	315	8584
	Non-Energy	933	100	250			1283
	Total	9914	7425	9680	823	315	28157
PAD District III							
	Residential/Commercial	371	6	848			1225
	Industrial	775	110	5284			6169
	Transportation	2314		393			2707
	Electric Utilities	171	590	2370	220	131	3482
	Non-Energy	1887	8	613			2508
	Total	5518	714	9508	220	131	16091
PAD District IV							
	Residential/Commercial	124	33	310			467
	Industrial	165	66	298			529
	Transportation	585		12			597
	Electric Utilities	51	245	85	16	262	659
	Non-Energy	116	5	-			121
	Total	1041	349	705	16	262	2373
PAD District V							
	Residential/Commercial	323	10	1125			1458
	Industrial	614	44	1289			1947
	Transportation	3489		74			3563
	Electric Utilities	827	75	1102	204	1650	3858
	Non-Energy	375	3	39			417
	Total	5628	132	3629	204	1650	11243
	U.S. Total	38189	11041	28698	2556	2840	83324

Sources listed at end of table.

TABLE IA cont.

U. S. Primary Energy Demand Projection
by Consuming Sector and PAD District
1980

(10^{12} BTU's)

	Sector	Petroleum	Coal	Natural Gas	Nuclear	Hydro	Total
PAD District I							
	Residential/Commercial	3619	75	2723			6417
	Industrial	1640	550	2666			4856
	Transportation	8057		107			8164
	Electric Utilities	6077	1225	610	2876	497	11285
	Non-Energy	992	40	108			1140
	Total	20385	1890	6214	2876	497	31862
PAD District II							
	Residential/Commercial	1841	180	4597			6618
	Industrial	1376	1430	4673			7479
	Transportation	7013		411			7424
	Electric Utilities	456	6430	1708	1696	300	10590
	Non-Energy	1140	100	336			1576
	Total	11826	8140	11725	1696	300	33687
PAD District III							
	Residential/Commercial	417	6	1011			1434
	Industrial	913	110	6038			7061
	Transportation	2757		465			3222
	Electric Utilities	703	690	3062	439	154	5048
	Non-Energy	2380	8	971			3359
	Total	7170	814	11547	439	154	20124
PAD District IV							
	Residential/Commercial	138	30	349			517
	Industrial	212	66	327			605
	Transportation	702		14			716
	Electric Utilities	202	285	98	18	321	924
	Non-Energy	137	5	-			142
	Total	1391	386	788	18	321	2904
PAD District V							
	Residential/Commercial	347	9	1327			1683
	Industrial	721	44	1457			2222
	Transportation	4264		80			4344
	Electric Utilities	2198	30	912	576	1761	5477
	Non-Energy	463	3	30			496
	Total	7993	86	3806	576	1761	14222
	U.S. Total	48765	11316	34080	5605	3033	102799

Sources listed at end of table.

TABLE IA cont.

U. S. Primary Energy Demand Projection
by Consuming Sector and PAD District
1985

(10^{12} BTU's)

	Sector	Petroleum	Coal	Natural Gas	Nuclear	Hydro	Total
PAD District I							
	Residential/Commercial	3752	25	3242			7019
	Industrial	2012	550	3340			5902
	Transportation	9491		130			9621
	Electric Utilities	8290	1400	704	4373	494	15261
	Non-Energy	1267	40	300			1607
	Total	24812	2015	7716	4373	494	39410
PAD District II							
	Residential/Commercial	2044	60	5403			7507
	Industrial	1593	1430	5606			8629
	Transportation	8210		480			8690
	Electric Utilities	1717	6890	1850	2733	296	13486
	Non-Energy	1370	100	593			2063
	Total	14934	8480	13932	2733	296	40375
PAD District III							
	Residential/Commercial	505	2	1182			1689
	Industrial	1046	110	6872			8028
	Transportation	3230		551			3781
	Electric Utilities	1129	900	3976	763	153	6921
	Non-Energy	2997	8	1460			4465
	Total	8907	1020	14041	763	153	24884
PAD District IV							
	Residential/Commercial	216	10	394			620
	Industrial	261	66	361			688
	Transportation	859		16			875
	Electric Utilities	343	350	119	55	375	1242
	Non-Energy	164	5	1			170
	Total	1843	431	891	55	375	3595
PAD District V							
	Residential/Commercial	382	3	1548			1933
	Industrial	841	44	1626			2511
	Transportation	5160		87			5247
	Electric Utilities	3693		867	1093	1800	7453
	Non-Energy	565	3	57			625
	Total	10641	50	4185	1093	1800	17769
	U.S. Total	62137	11996	40765	9017	3118	126033

Sources listed at end of table.

TABLE IA cont.

(Sources)

Petroleum

Residential/Commercial Market: TABLE A1-III

Industrial Market: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 67.

Transportation Market:

TABLES A1-VI, -X, -XIV, -XVIII, -XXII

Electric Utility Market:

TABLE A1-XXVI

Non-Energy Market: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 69.

Coal

Residential/Commercial Market:

TABLE A2-III

Industrial Market: TABLE A2-IV

Electric Utility Market:

1970 - TABLE A2-XI

1975, 1980, 1985 - TABLE A2-XII

Non-Energy: TABLE V

Natural Gas

All markets excluding the electric utility market: TABLE A3-I.

Electric Utility Market:

FRC, Future Gas Requirements of the United States, vol. 4, October 1971, pp. 24, 30-56 using a conversion factor of 1031 BTU's/CF natural gas.

TABLE IA cont.

Nuclear

TABLE II

Hydropower

NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 185.

The general assumptions and data bases used in this study may be summarized as follows:

A. Petroleum, natural gas and hydropower estimates from the NPC intermediate forecast were used as a base for all forecasts.

B. The NPC total sector demand data, by PAD districts, provide the base national demand totals.

C. Natural gas estimates in the electric utility sector were modified to conform with those estimates prepared by the Future Requirements Committee. These figures were used because they are the latest available and are the source of the FPC estimates. In all other sectors, NPC revisions of FRC natural gas forecasts were used.

D. Fossil fuel mix percentages in the electric utility sector were derived by extrapolation of percentage distributions for the years 1966-1971.

E. Electric utility coal demand was determined from the assumed percentage mix estimates (natural gas held constant) applied to the base NPC petroleum and FRC natural gas forecasts.

F. Nuclear totals were based on those provided by the BOM. The NPC total estimates were not used because they failed to account for plant construction delays and generation obstacles (i.e., environmental and technical restrictions). District percentage distribution of the total BOM estimates were made by using the AEC and NPC distributions, but with a lower assumed capacity in electrical generation. Capacity load factors and heat rates were those computed by the BOM.

G. Petroleum estimates were allowed to swing in order to equal the base NPC total estimates for the electric utility sector. Final fuel mix and percentages are given in Tables III and A2-V.

H. Based on the estimated coal demand by user, coal use was determined from the computed coal demand within the electric utilities sector. Inconsistencies exist between the NPC estimates and the BOM data from which the percentage distributions were derived. Coking coal was excluded from industrial coal use.

I. Petroleum estimates in the residential/commercial and industrial sectors settled the balances of total base demand. Coal decreased as a percentage share of total demand in this market, while oil increased, under the assumption that sulfer oxide emission controls will be pro- but not retro-fitted; that there is the possibility of a ban on strip mining before 1985; that oil import restrictions are relaxing.

Tables I and IA present the energy demand projections derived on a fuel unit and BTU basis respectively. Data are presented for five year intervals from 1970-1985 for each of the five PAD districts. Within each district, the consuming sectors considered are: residential/commercial, industrial, transportation, electric utility and nonenergy. Data are presented for petroleum, coal, natural gas, nuclear power and hydropower. A comparison of these estimates with those of the NPC, on a fuel unit basis, is presented in Table IB. Because the NPC Coordinating Committee did not provide a comparable regional breakdown of its estimates on a fuel unit basis for coal and nuclear power, the comparisons are limited.

The major differences between the current and the NPC forecast is in the area of nuclear power. The difference between the two becomes progressively greater. By 1985, the current forecast is 165,000 MWe. This is only slightly more than half the 300,000 MWe predicted by the NPC. While this forecast projects a nuclear power supply equal to 165,000 MWe by 1985, by considering recent data released by the FPC, and using a ten year plant construction lead time,it can be seen that this may be an overstatement. The FPC in its Bulk Power Supply Docket, reported on April 1, 1974[5] that, as of the reporting date, there were 115 nuclear plants being built or on order to begin construction by 1975. Using a midpoint estimation of plant size by class range, this includes a

TABLE IB

A Comparison of the Current Energy Demand Forecast with the Combined NPC Task Group Forecasts for Individual Fuels by PAD District and Market - 1970

	Petroleum (10^6 B/Yr)		Coal (10^6 T/Yr)		Natural Gas (10^9 CF/Yr)		Nuclear (MWe)		Hydro (BKWH)
	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current and NPC Forecast
PAD District I									
Residential/Commercial	550	550	2.9		1800	1800			
Industrial	177	177	27.5		1284	1284			
Transportation	1024	976			65	65			
Electric Utility	286	285	111.3		505	505	4182	4182	44.2
Non-Energy	106	106	1.9		117	209			
Total	2143	2294	143.6		3771	3863			
PAD District II									
Residential/Commercial	279	279	10.9		3197	3197			
Industrial	155	155	50.0		2478	2478			
Transportation	929	909	-		252	252			
Electric Utility	14	14	177.3		971	971	2226	2226	30.1
Non-Energy	124	124	3.4		190	710			
Total	1501	1481	241.6		7088	7608			
PAD District III									
Residential/Commercial	56	56	.1		734	734			
Industrial	117	116	2.3		4140	4140			
Transportation	364	391	-		305	305			
Electric Utility	1	2	22.3		1617	1617	-		10.8
Non-Energy	289	289	.1		403	1831			
Total	827	854	24.8		7199	8627			
PAD District IV									
Residential/Commercial	20	20	.8		260	260			
Industrial	21	21	1.5		238	238			
Transportation	90	86	-		10	10			
Electric Utility	2	2	8.0		63	63	-		19.0
Non-Energy	15	15	.1		2	104			
Total	148	144	10.4		573	627			
PAD District V									
Residential/Commercial	46	46	.2		910	910			
Industrial	79	79	.3		897	897			
Transportation	502	498	-		57	57			
Electric Utility	29	29	.9		759	759	499	499	144.9
Non-Energy	49	49	-		54	262			
Total	705	701	1.4		2677	2885			
U.S. Total	5324	5274	421.8	446	21308	23658	6907	6907	249

Sources are listed at end of table.

TABLE IB cont.

A Comparison of the Current Energy Demand Forecast
with the Combined NPC Task Group
Forecasts for Individual Fuels by
PAD District and Market - 1975

	Petroleum (10^6 B/Yr)		Coal (10^6 T/Yr)		Natural Gas (10^9 CF/Yr)		Nuclear (MWe)		Hydro (BKWH)
	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current and NPC Forecast
PAD District I									
Residential/Commercial	597	604	2.9		2260	2260			
Industrial	218	218	21.2		2071	2071			
Transportation	1249	1205			88	88			
Electric Utility	615	540	77.4		566	566	30564		46.0
Non-Energy	129	129	1.5		168	251			
Total	2808	2696	103.0		5153	5236			
PAD District II									
Residential/Commercial	332	316	7.0		3896	3896			
Industrial	190	191	55.0		3699	3699			
Transportation	1104	1103	-		342	342			
Electric Utility	41	41	252.2		1448	1448	17856		30.1
Non-Energy	159	159	3.7		242	868			
Total	1826	1810	317.9		9627	10253			
PAD District III									
Residential/Commercial	85	65	.2		848	848			
Industrial	132	131	4.2		5284	5284			
Transportation	435	477	-		393	393			
Electric Utility	28	7	26.1		2298	2298	4869		12.5
Non-Energy	395	395	.3		595	2079			
Total	1075	1075	30.8		9418	10902			
PAD District IV									
Residential/Commercial	24	24	1.2		310	310			
Industrial	28	28	2.5		298	298			
Transportation	109	107	-		12	12			
Electric Utility	8	2	10.8		83	83	330		25.0
Non-Energy	18	18	.2		-	115			
Total	187	179	14.7		703	818			
PAD District V									
Residential/Commercial	58	48	.4		1125	1125			
Industrial	103	103	1.7		1289	1289			
Transportation	643	629	-		74	74			
Electric Utility	132	30	3.3		1068	1068	4661		157.4
Non-Energy	64	64	.1		38	220			
Total	1000	874	5.5		3594	3776			
U.S. Total	6896	6634	471.9	536	28495	30985	58280	59000	271

Sources are listed at end of table.

TABLE IB cont.

A Comparison of the Current Energy Demand Forecast
with the Combined NPC Task Group
Forecasts for Individual Fuels by
PAD District and Market - 1980

	Petroleum (10^6 B/Yr)		Coal (10^6 T/Yr)		Natural Gas (10^9 CF/Yr)		Nuclear (MWe)		Hydro (BKWH)
	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current and NPC Forecast
PAD District I									
Residential/Commercial	623	646	2.7		2723	2723			
Industrial	274	273	21.2		2666	2666			
Transportation	1491	1469	-		107	107			
Electric Utility	973	690	54.2		592	592	51318		48.5
Non-Energy	175	175	1.5		105	284			
Total	3536	3253	79.6		6193	6372			
PAD District II									
Residential/Commercial	355	336	6.4		4597	4597			
Industrial	237	237	55.0		4673	4673			
Transportation	1315	1338	-		411	411			
Electric Utility	74	76	284.5		1655	1655	30268		29.3
Non-Energy	196	196	3.7		326	819			
Total	2177	2183	349.6		11662	12155			
PAD District III									
Residential/Commercial	95	75	.2		1011	1011			
Industrial	156	155	4.2		6038	6038			
Transportation	517	578	-		465	465			
Electric Utility	115	14	30.5		2965	2965	7828		15.0
Non-Energy	502	502	.3		942	1990			
Total	1385	1324	35.2		11421	12469			
PAD District IV									
Residential/Commercial	27	28	1.1		349	349			
Industrial	36	36	2.5		327	327			
Transportation	131	130	-		14	14			
Electric Utility	32	2	12.6		95	95	330		31.3
Non-Energy	21	21	.2		-	122			
Total	247	217	16.4		785	907			
PAD District V									
Residential/Commercial	63	49	.3		1327	1327			
Industrial	121	122	1.7		1457	1457			
Transportation	784	783	-		80	80			
Electric Utility	351	79	1.3		885	885	10300		171.9
Non-Energy	79	79	.1		29	242			
Total	1398	1112	3.4		3778	3991			
U.S. Total	8743	8089	484.2	642	33839	35894	100044	150000	296

Sources are listed at end of table.

TABLE IB cont.

A Comparison of the Current Energy Demand Forecast
with the Combined NPC Task Group
Forecasts for Individual Fuels by
PAD District and Market - 1985

	Petroleum (10^6 B/Yr)		Coal (10^6 T/Yr)		Natural Gas (10^9 CF/Yr)		Nuclear (MWe)		Hydro (BKWH)
	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current Forecast	NPC Forecast	Current and NPC Forecast
PAD District I									
Residential/Commercial	647	684	.9		3242	3242			
Industrial	337	337	21.2		3340	3340			
Transportation	1761	1716	-		130	130			
Electric Utility	1327	757	61.9		682	682	80000		50.0
Non-Energy	227	227	1.5		291	320			
Total	4299	3721	85.5		7685	7714			
PAD District II									
Residential/Commercial	395	365	2.1		5403	5403			
Industrial	276	227	55.0		5606	5606			
Transportation	1539	1551	-		480	480			
Electric Utility	278	84	304.9		1793	1793	50000		30.0
Non-Energy	238	238	3.7		575	782			
Total	2726	2456	365.7		13857	14064			
PAD District III									
Residential/Commercial	116	84	.1		1182	1182			
Industrial	239	179	4.2		6872	6872			
Transportation	606	677	-		551	551			
Electric Utility	184	17	39.8		3852	3852	14000		15.5
Non-Energy	634	634	.3		1416	1774			
Total	1779	1591	44.4		13873	14231			
PAD District IV									
Residential/Commercial	43	31	.4		394	394			
Industrial	44	45	2.5		361	361			
Transportation	162	156	-		16	16			
Electric Utility	55	2	15.5		116	116	1000		38.0
Non-Energy	25	25	.2		1	119			
Total	329	259	18.0		888	1006			
PAD District V									
Residential/Commercial	71	49	.1		1548	1548			
Industrial	142	142	1.7		1626	1626			
Transportation	950	938	-		87	87			
Electric Utility	589	113	-		829	829	20000		182.5
Non-Energy	97	97	.1		55	241			
Total	1849	1339	1.9		4145	4331			
U.S. Total	10982	9366	516.1	767	40448	41346	165000	300000	316

Sources are listed at end of table.

TABLE IB cont.

(Sources)

Current Forecast: Table I

NPC Forecast: The NPC fuel forecast figures are those of the individual Fuel Task Groups, not the generalized Energy Demand Task Group. It was impossible to compare the current forecast with the NPC general forecast. The NPC market based forecast did not present fuel demand by district in individual fuel units. Rather, all tables are given on a BTU basis by market and PAD district only. (See NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, pp. 1-13.) The NPC Coordinating Committee did not incorporate explicitly by table the projected fuel demands (by market and PAD district in fuel units) into the Energy Demand Task Group totals (See Ibid., p. xxv).

Residential/Commercial Market - Table D-I
Industrial Market - Table D-II
Transportation Market - Table D-III
Electric Utility Market - Table D-IV
Non-Energy -

Petroleum: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985", U.S. Energy Outlook: An Interim Report, 1972, pp. 69-70.

Coal: NPC, U.S. Energy Outlook: Coal Availability, 1972, p. 92.

Natural gas: NPC, U.S. Energy Outlook: Gas Demand, 1973, p. 10.

NPC coal demand estimates by district and user were not compared with the current forecast as the NPC coal estimates were published only on a national level by user. No regional breakdown for coal demand has been found in the NPC publications to date. The NPC's national coal forecast by user follows: (10^6 T/Yr)

Market	1970	1975	1980	1985
Residential/Commercial	10	7	5	3
Industrial	91	87	84	80
Transportation	0.298	-	-	-
Electric Utility	322	415	525	654
Non-Energy	23	27	28	30
Total	446	536	642	767

TABLE IB cont.

The Non-Energy coal demand was determined by using 26,000,000 BTU's/Ton as a conversion factor.

The NPC nuclear estimates used are the Nuclear Task Groups intermediate (AEC) estimates. The NPC's Case IV (low) estimates for 1980 and 1985 are 107,000 and 240,000 MW(e) respectively. See NPC, U.S. Energy Outlook, Nuclear Energy Availability, p. 21.

In general, if the individual Fuel Task Groups forecasts are summed as given, then the overall energy demand levels for 1975, 1980, and 1985 should add to 88,620; 110,074; and 137,672 x 10^{12} BTU's respectively. See NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol.2,, Nov. 1971, p. XXV for a coordinated estimate.

total of 114,450 MWe. Adding this to the 1972 level of plant installation, the total falls short of the 165,000 MWe forecasted for 1985. Even if all the plants reported by the FPC are placed at the upper limits of their respective size classes, the 114,450 MWe figure expands to only 120,200 MWe. If this new total is added to the 1972 plant levels of capacity, the result falls short of the 1985 estimate forecasted in this study. Reaching the 165,000 MWe level by 1985, implies that the operational capacity of nuclear plants in 1972 was 45,000 MWe. This, of course, is an overstatement. Similarly, the difference between the current and the NPC coal forecasts increase over time. As a result of these two differences, the current forecast exceeds that of the NPC for petroleum. This is a result of adopting the NPC total energy demand forecast on a BTU basis.

The results of the special study of the electric utility market, with special emphasis on nuclear power, are presented in Tables II-IV. Finally, nonenergy fuel demand totals are shown in Table V. The supporting tables for the present projections are found in Appendix A.

Two caveats must be issued concerning this report: first, with the exception of nuclear and hydropower, an attempt has been made to present a demand study unconstrained by reported supply limitations; and second, the reported estimates of petroleum and natural gas demand cannot, of themselves, be said to constitute a basis from which to argue for increased imports of these fuels. Both of these warnings are related,and this report can only be considered a first step in their resolution. The supply limitations on nuclear power are temporary. They arise because of construction rates and lead times within the time frame of this report. The hydropower limitation is based on the development of available sites.

Dropping constraints on the supply of other fuels is based on the argument that producer export embargoes are temporary while consumer import embargoes exist at the whim of the government. What remains, in the time frame under discussion, are fuel prices. It is anticipated that these will rise substantially above the levels existing at the time of the NPC and other agency reports. On the supply side, this is precisely the mechanism for increasing producible reserves. The increases will occur not only in the U.S., but worldwide. The push for oil

development and exploration in the North Sea, Alaska and, ex ante, places heretofore thought to be even more unlikely, is ample demonstration of this simple fact.

Unless the demand for fuel is very inelastic with respect to price, the increased prices will slow down the rate of growth of energy demand. Given increases in income, it is unlikely to halt or reverse the growth of demand. As all previous energy forecasts have been understatements, it is possible that this one may be closer to the mark. However, the demand for particular fuels, as distinct from energy, will depend on relative fuel price increases,and these may differ among PAD districts and consuming sectors.

The translation of petroleum and natural gas estimates into import schedules depends upon a number of factors not developed in this study. The principal component is the expansion of domestic fuel supplies and related processing or refining facilities,and the results of energy conservation programs. In turn, these are creatures not only of price, but of government tax and fuel policy as well.

METHODOLOGY

I. GENERAL

The object of this study was to obtain demand estimates, for each of the major fuels, expressed in their respective fuel units, for each of the five PAD districts, for the major consuming sectors, for the period from 1970-1985. The fuels consisted of natural gas, petroleum, coal, nuclear and hydropower. New energy forms and exotic fuels were omitted on the assumption that their use would be minimal prior to 1985. The consuming sectors were defined as residential/commercial, industrial, transportation, electric utility and nonenergy.

For the overall demand estimate, on a BTU basis, the intermediate forecast[6] made by the NPC Coordinating Committee was used. No attempt was made to justify or revise this estimate. However, revisions were made in the NPC total fuel use estimates and in the fuel use mix in specific market sectors. The overall demand estimate was used simply as a ceiling, or national energy demand estimate. Except for hydropower and nuclear energy, for which supply limitations are of a different order of magnitude than for other fuels, an attempt was made to eliminate supply limitations from the demand estimates.

In terms of the ordering of the individual demand estimates, the demand for natural gas in all market sectors and all PAD districts was considered first. This was based on the NPC study. Next the coal estimate was derived for all consuming markets in each PAD district. The demand for hydropower and nuclear energy in the electric utility industry in each PAD district was then added. Comparing these with the total energy demand estimate in each district, resulted in the demand estimate for petroleum. In this sense, crude oil and petroleum products were residually derived. The natural gas estimate was based on an estimate made by the NPC Task Group.[7] The regional coal forecast was based on distribution trends, national forecasts and some specific assumptions. The exclusion of coking coal in the present forecast was a major determinant of the resultant coal estimates.

The electric utility market was estimated separately. The forecast in this study was based on the NPC hydropower forecast and an independently calculated nuclear power forecast. The nuclear energy supply/demand estimates are based on construction reports released by

the AEC and FPC,[8] adjusted by assumed load factors, heat rates and standard conversion rates. This procedure resulted in a necessary alteration of NPC estimates of natural gas, petroleum and coal estimates in this market sector.

II. MARKET SECTORS

A. Residential/Commercial

The NPC projects fossil fuel demand in the residential/commercial sector of the U.S. energy market growing at the rate of 2.5 percent annually through the year 1985. This is based on a series of assumptions concerning the growth in the number of households, homeowners, apartment dwellers, population shifts, energy costs, environmental controls, GNP growth rates and energy/GNP ratios. A listing of the NPC assumptions are found in Appendix B of this report. In the residential sector, the most important assumptions are: a population shift to the suburbs and an increase in the number of households from 63 million (1970) to 81 million (1985), a 1.1 percent average annual increase in total population, a slower rate of growth in the number of single-family dwellings than the rate existing between 1960-1970, and a decreasing demand for larger homes.

In the commercial sector, the NPC projects an annual GNP growth rate in excess of 4 percent, forecasts rising personal incomes, and assumes a standard of living equal to that of the 1960's. These serve as indices for determining the commercial portion of this market.[9]

The NPC total demand forecast in this market has not been altered. However, the fossil fuel consumption mix has been changed slightly. Petroleum demand has been altered in order to maintain the level of the NPC overall demand forecast on a BTU basis. The methodological basis and its justification is as follows: first, in determining the specific fuel requirements within the residential/commercial sector, the NPC natural gas forecasts were adopted;[10] next, coal estimates were derived from national BOM estimates of distribution; and, petroleum demand was assumed to equal the difference between the sum of these two from total demand.[11]

The coal data are based on BOM coal data rather than NPC coal data for two reasons. First, the BOM data are more extensive and more sophisticated than those of the NPC. They appear to be a more reliable

source for deriving past coal distribution (consumption) trends. Second, the BOM projections of future consumption are more closely correlated to past BOM distribution data than are NPC projections. The procedure used in obtaining coal demand forecasts starts with the measurement of coal distribution by region. To establish the trend of this distribution one can go back only to 1969. This is due to the impact on coal of the newly enacted air pollution control regulations. The distribution trend is expressed in terms of both the tonnage of coal distributed and the percentage of total coal shipments into each region. In extrapolating this trend, it was assumed that the decrease in the national usage of coal in this sector, forecast by both the NPC and the BOM, is uniform across regions. Constant percentage shares of coal consumption by PAD district are, therefore, assumed for the period from 1975 to 1985 in the application of the national BOM forecasts. The present forecast is the result of transforming these derived distribution forecasts into a consumption forecast.

B. Industrial

The NPC forecast of fuel demand in the industrial market is based on a 2.0 - 2.3 percent annual growth rate through the year 1985. Among the general NPC assumptions are: the trend toward large, well-lighted, air-conditioned factories will continue, improvements in product quality will require additional energy consumption, energy requirements will increase due to the increased use of lower grade ores in the processing industries and, finally, the costs involved in fuel switching in the industrial sector and stricter environmental regulations are expected to limit fuel substitution opportunities in the industrial sector. The last two assumptions also limit the adjustment in fuel use, made in this study, of the individual fuel demand forecasts made by the NPC Task Groups.

The procedure for determining the total industrial market demand by region was to sum the component fuel consumption demands reported by the appropriate NPC fuel Task Groups to the demand for coal derived in this study. The forecast of natural gas demand as a fuel component was that reported by the NPC Gas Demand Task Group in their 1973 revised forecast.[12] This revision is a reflection of a change in the estimates of the Future Requirements Committee made between 1969 and 1971.[13]

The petroleum forecast used is that of the NPC Oil Demand Task Group.[14] Coal, the remaining fuel component, was projected through 1985 on the basis of process heat requirements. This excludes coking coal which represents a chemical process.[15]

In this study, the coal demand forecast is slightly higher than that of the initial NPC coal demand forecast due to differences in assumptions. Here it is assumed that improved coal gasification processes will provide little synthetic natural gas to offset any shortfall in the supply of natural gas to the industrial sector. Thus, coal demand is projected as a constant from 1975 to 1985. The NPC projects a decrease in coal demand of one percent per annum through 1985. The difference in the estimates is small with respect to total market demand.

In this study, total demand estimates in all PAD districts in the industrial sector are higher than the intermediate NPC total demand estimates, excluding coking coal, for several reasons. First, the NPC estimates of total demand are based on the assumption of a limit to the availability of natural gas for industrial use and restrictions on the use of coal because of air pollution control regulations. Here, neither coal nor natural gas demand is restricted for these reasons. Also, in this study, the NPC petroleum demand forecasts are used. If petroleum estimates had been allowed to decline in order that the fossil fuel demand sum equal the industrial demand forecast by the NPC, in certain PAD districts this would have implied a negative petroleum demand. Further, because of restricted fuel substitution, an increase in coal and natural gas demands are not directly correlated with a decrease in petroleum demand. Therefore, the sum of the present fuel demand estimates show a higher total industrial demand than does the NPC industrial demand (excluding coking coal) forecast. The result of this procedure is that the U.S. total energy demand estimates for 1975, 1980 and 1985 are closer to the NPC high estimates than to their intermediate forecasts.[16]

C. Transportation

The transportation sector runs almost exclusively on oil.[17] Thirteen fuels comprise this market demand. The fuels used, with their respective BTU conversion factors in parentheses, are as follows:[18] motor and aviation gasoline (5,248,000 BTU/barrel), naphtha based jet fuel (5,355,000 BTU/barrel), kerosine based jet fuel (5,670,000 BTU/barrel),

distillate fuel for vessels, railroads and highway use (all at 5,825,000 BTU/barrel), kerosine for highway use (5,670,000 BTU/barrel), bunker fuel oil and military residual fuel oil (6,287,000 BTU/barrel), liquefied petroleum gas and liquefied natural gas for internal combustion engines (4,011,000 BTU/barrel), and military distillate fuel oil (5,825,000 BTU/barrel). Adding natural gas demand to the demand for these oil products, the NPC estimates a 3.7 percent annual growth rate in demand in the transportation sector through the year 1985.

The major NPC assumptions in this sector are a continuing increase in per capita income associated with an increased expenditure on cars, and increased opportunities for vacation travel. Additional automotive power accessories and pollution control devices are both expected to force consumption higher. Population shifts to the suburbs are used to imply an increased use of suburban highways and rural roads, both of which mean greater commuting distances. Some of this travel will be offset by the construction of shopping centers and job relocation movements. Finally, air transport demand is assumed to increase at a rate more than double that of the total transport market. With these assumptions, the overall NPC transportation market forecast has been adopted in this study. This has required a slight readjustment in the oil consumption estimates made by the NPC in order to equal their total transport market demand estimates. Simply adding the NPC's petroleum estimates to their natural gas estimates in this sector results in a different level of total market demand than that presented by the NPC. This suggests that a reconciliation was made by the NPC's Coordinating Committee. The reconciliation adjustment was eliminated in this paper. Therefore,the NPC natural gas forecast in this sector was subtracted from the NPC total transport demand estimate, to produce the petroleum demand estimate.

In order to equate with the NPC petroleum forecast, the percentage share that each oil product constituted in the NPC total oil demand forecast was calculated. The resulting weighted product averages, by PAD district, of total oil consumption were applied to the total oil consumption estimates in order to make a specific product demand forecast.[19] This also served as a conversion process in the transformation of oil demand from a BTU to a fuel unit basis.

The net effect of this procedure did not greatly change the NPC oil demand forecasts in the transportation sector. It did result in a reformulated demand forecast which achieved intertabular and methodological consistency. As a result, the summation of the NPC Oil Demand Task Group's overall demand estimates are left intact. The reconcilliation by the NPC Coordinating Committee has been eliminated.

D. Electric Utilities

Demand for specific fuels in the electric utility market depends on both national and regional demand and on the expected availability of specific types of new electric generating plants. Given lengthening lead times, construction problems and manpower difficulties associated with nuclear plant completions,(20) the lack of aggressive action aimed at providing the technology necessary to reduce coal-oriented air pollution, FPC policy aimed at discouraging the electric utility industry from using natural gas, and limits on oil importation, the future fuel mix for electric generating plants is unclear. Demand for specific fuels in this sector will ultimately depend on the availability of the plants designed to utilize each fuel. In turn, this depends on the probability that the plants can be constructed at the desired rate. There is a significant discrepancy between AEC projections of the demand (supply) of nuclear power and what is materializing in terms of nuclear power plants built, being built, and planned. Without the available plant capacity to meet an optimistic nuclear power supply estimate, the demand for electric power must shift to an alternate fuel if forecast total electric power demand is to be met. This results in a necessary expansion of fossil fuel plant construction which is not without its own complications. A reduction in the rate of construction of coal fired plants is presently in effect,(21) based on air pollution control regulations and the rate of development of air pollution control technology and implementation.

In the present forecast, it is assumed that controls will not be relaxed and that any major technological breakthrough will not be extensively applied prior to 1985. Second, while expectations of natural gas supply limitations may limit the expansion of gas fired plants to a rate which does not correspond to the demand estimates currently forecast, this report does not limit the demand estimate for this fuel.

TABLE II

Demand for Nuclear Energy

Installed Generating Capacity - Megawatts

PAD District	1970	1975	BOM 1975	1980	1985
I	4182	30564	25175	51318	80000
II	2226	17856	16025	30279	50000
III	0	4869	4275	7828	14000
IV	0	330	330	330	1000
V	499	4661	3975	10300	20000
Total	6907	58280	49780	100044	165000

Load Factors

1975 = .55 4818 Hours
1980 = .60 5256 Hours
1985 = .60

Net Generation (10^6 KWH)

I	147257	121300	269727	420480
II	86030	77200	159089	262800
III	23459	20600	41144	73584
IV	1590	1500	1734	5256
V	22457	19150	54137	105120
Total	280793	239750	525831	867240

Heat Rate (BTU's/KWH)

1975	10660
1980	10660
1985	10400

Nuclear Plants

Energy Resource Inputs (10^{12} BTU's)

I	147	1570	1293	2876	4373
II	32	917	823	1696	2733
III		250	220	439	763
IV		17	16	18	55
V	63	239	204	576	1093
Total	242	2993	2556	5605	9017

This table gives the projected plant capacities based on 6-year lead times (construction) and FPC data relating to plant construction.

Sources: FPC,"Bulk Power Supply Information, April 1, 1972, Released Sept. 14, 1972, Washington.

Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, December 1972, p. 26.

TABLE III

Fuel Mix in the Electric Utility Market

(Percentage of Total)

	Petroleum	Coal	Natural Gas	Nuclear	Hydro
1970					
PAD District					
I	32	48	9	3	8
II	2	73	19	1	5
III	0	21	74	-	5
IV	3	35	15	-	47
V	7	1	30	2	60
Total	13	44	25	1.5	16.5
1975					
PAD District					
I	48	22	7	16	6
II	3	66	17	10	4
III	5	17	68	6	4
IV	8	37	13	2	40
V	21	2	29	5	43
Total	21	34	23	10	12
1980					
PAD District					
I	51	11	5	28	5
II	4	59	16	19	2
III	10	14	61	12	3
IV	21	31	11	2	35
V	35	-	17	16	32
Total	29	26	19	17	9
1985					
PAD District					
I	54	9	5	29	3
II	13	51	14	20	2
III	17	13	57	11	2
IV	28	28	10	4	30
V	49	-	12	15	24
Total	34	22	17	20	7

Source: TABLE IA

TABLE IV

Electric Utility Demand

(10^{12} BTU's)

	Total	Petroleum	Coal	Natural Gas	Nuclear	Hydro
1970	16267	2088	7229	4040	242	2677
1975	24534	5144	8360	5634	2556	2840
1980	33324	9636	8660	6390	5605	3033
1985	44363	15172	9540	7516	9017	3118

Source: TABLE IA

In this forecast the NPC electric utility total demand estimate, hydropower and natural gas demand forecasts have been adopted. However, coal demand has been recast by PAD district, and a nuclear power demand forecast has been developed which coincides with actual nuclear plant construction plans. The petroleum demand estimate is the difference between these and the total electric utility demand forecast by the NPC.

The following discussion indicates how the fuel mix for electric utilities was determined. Following a formal request by the FPC, the Future Requirements Committee (FRC) established a regional estimate of natural gas requirements in the electric utility industry. The FRC estimates were used by the NPC and adopted in this study.(22) The total fossil fuel demand estimate was made given the assumption that natural gas would remain a constant share of total fossil fuel demand through 1985. Next, a regional coal demand forecast was derived.(23) Given the fossil fuel consumption mix in terms of percentage shares, the BTU and tonnage level of demand for coal may be slightly overestimated due to the conversion factor used in converting the demand for natural gas to BTU's.(24) If a lower conversion factor (1000 BTU/cu. ft. rather than 1031 BTU/cu. ft.) had been used, the total BTU content of fossil fuel demand derived from the natural gas forecast (as a fixed percentage of total fossil fuel demand) would have been lower. Hence, correspondingly lower coal estimates would have been obtained.

In the area of nuclear power, gross differences were found between the forecast of estimated demand in this study and that of the NPC forecast.(25) The general procedure for obtaining the new nuclear power demand forecast follows. First, the 1970 NPC nuclear demand estimate was accepted; second, the nuclear power electric generating plants on order in 1972, due to begin construction prior to 1974, were listed, by location and expected data of commercial operation;(26) and third, based on the list of plants, which indicates the number and capacity for 1975 to 1980, the 1985 nuclear power capacity was extrapolated.

The basic data sources were the FPC, AEC, and BOM.(27) The 1970 estimates were based on AEC (NPC) data,(28) the 1975 estimates come from BOM data,(29) and the 1980 estimates are based on both AEC and FPC data.(30) The 1985 estimates are an extrapolation of these previous estimates. The BOM was chosen as the source for the 1975 forecast because

it was found that 1975 forecasts based on AEC/FPC plant construction information led to a probable overestimate due to recently experienced shifts in anticipated construction completion dates and start-up difficulties which have occurred in completed plants.

Statistics on construction delays are best explained by industry experience[31] in plant installation plans as reported by both the AEC[32] and the FPC.[33] The AEC has indicated significant set-backs in planned nuclear plant installment dates.[34] Between 1970 and 1972, completion dates for plants "being built" or "planned" were set back one or two years each. In September 1972, the FPC indicated a set-back of one or two years for 30 plants.[35] Thus, between 1970 and 1973 almost 60 plants had their construction completion dates set back one year each. There is some double counting of those plants for which the lead times were lengthened by two years or were set-back according to the AEC publication and later set back still further in an FPC News release. Further delays are inevitable. Thus the FPC estimates are biased upwards. The BOM forecast may also have an upward bias if further delays occur within the next two years at the same rate at which delays have occurred over the past three years. However, in this study it is assumed that this will not occur and, further, that there will be no delays beyond 1975. This optimistic assumption may cause an overestimation of nuclear capacity. It was used, consistent with AEC practice, to produce an upward, rather than a downward bias in the estimates.

Nuclear power plant load factors for 1975 and 1980 were set at 55 or 60 percent respectively while the heat rate conversion was assumed to be 10,660 BTUkwhr. This is consistent with assumptions made by the BOM and is above past realizations. The total nuclear power input into the electric utility market is forecast at 2556 and 4605 trillion BTU's in 1975 and 1980 respectively. With a load factor of 60 percent and a heat rate of 10,400 BTU/kwhr.,[36] a 9017 trillion BTU input into the utility sector for 1985 is forecast. In terms of plant installation, this means that from 1970 to 1975 an installation rate of nine 1000 MWe plants per year is projected. The plant addition rate from 1975 to 1980 is forecast to average ten 1000 MW plants annually and the extrapolation from 1980 to 1985 requires that the yearly plant addition rate increase to thirteen 1000 MW plants. The 1970 to 1980 estimates

are based on plants that have yet to be officially placed on order. Since all of the estimates are based on the assumption of a six-year lead time for construction, changes in the length of expected construction periods results in changes in capacity estimates. If it is assumed that the lead time is eight years, the 1980 forecast shifts back to 1982, implying that the nuclear construction industry would be required to accelerate plant installations from ten to seventeen 1000 MW plants per year from 1982 to 1985. A ten-year lead time for nuclear power plant installation makes the estimates for 1980 and 1985 unattainable. No installation rate short of 65 plants in 1984 achieves the forecast level of plant capacity for 1985. Table II shows the basis for the nuclear forecast in greater detail.

By way of comparison, nuclear capacity (in megawatts) was forecast by the AEC and the Atomic Industrial Forum (AIF) as follows:

Year	AEC (1962)	AEC (1968)	AEC (1972)	AIF (1972)	AIF (1973)
1980	40,000	150,000	132,000	146,000	146,000
1985	100,000	300,000	280,000	302,000	365,000

The AEC (1962) forecast sets a lower bound to the estimates in the present study. Their forecast was made at the time the nuclear power development program was delineated. Based on a 15 year or longer plant construction lead time, the 1985 figure would be almost accurate. The AIF forecast represents a maximum estimate. It assumes that present restrictions imposed by licensing, technical and construction manpower limitations, development of additional uranium supplies, siting, financing and insurance are substantially diminished and a massive national movement to develop nuclear power materializes. The likelihood is small, but serves as an upper bound to estimates of nuclear power capacity.

The hydropower contribution to the electric utility market is that of the NPC estimate of projected hydropower demand. However, if one adds the NPC petroleum demand estimates to the demand for natural gas, coal, nuclear power and hydropower, the demand total is different than that forecast by the NPC Coordinating Committee. The methodology adopted in this study requires that estimates of component fuel demands be equated to the NPC total demand estimate in each market sector. Therefore, petroleum serves as a swing fuel up to, but not significantly

below, the NPC market demand estimate.[37] Because the total of the individual fuel demand estimates exceeded the total forecast by the NPC Coordinating Committee in PAD District II for the years 1975 and 1980, and in order to prevent an estimated petroleum demand level far below that projected by the NPC, a methodological exception was made in this market. This was done in order to maintain consistency with the coal and natural gas demand estimates.

The fuel mix in Table III indicates the percentage shares of each fuel of total consumption in the electric utility industry by PAD district. It is based on the forecasts of the NPC as modified. The market shares of petroleum and nuclear energy are projected to increase while those of coal, natural gas and hydropower are expected to decrease. Natural gas is assumed to maintain a constant share of this market in relation to petroleum and coal,[38] but decreases, in market share with respect to total sources of electrical generation.[39] The coal and hydropower decreases are due to environmental, economic and physical constraints.

Electric utility fuel demand is summarized in Table IV. The 1970, 1975, 1980 total demand estimates are modifications of the intermediate NPC utility forecast. Where the individual fuel estimates did not equal the NPC PAD District and national estimates, they are upward revisions of the NPC forecast. This occurs because, in the calculation of coal and petroleum demand within each PAD district, the high coal estimates in PAD District II implies an increase in the NPC electric utility demand forecast. Although the methodology required petroleum to swing, once coal, natural gas, nuclear and hydropower forecasts were fixed, in PAD District II the NPC forecast for petroleum was low and adjustment would have required that the petroleum demand estimate be negative. Therefore, in order to maintain the NPC petroleum estimates, it was necessary to readjust the total NPC electric utility demand forecast. This resulted in a shift upward in total energy demand and is the single methodological exception.

Petroleum demand in the electric utility market is divided between residual and distillate fuel oils, where residual demand far exceeds that of distillate. Based on NPC petroleum product demand estimates,[40] the percentage contribution of the two products to total market demand

was derived. From this and the total petroleum demand estimates, the product demand in BTU's were computed. Conversion using the following factors[41] then determined the estimates presented in Table A1-XXV

Residual fuel oil:	6,287,000 BTU/barrel
Distillate fuel oil:	5,825,000 BTU/barrel

E. Nonenergy

The NPC defines nonenergy and miscellaneous fuel use as follows: "The nonenergy sector includes all fossil fuels (chiefly petroleum) that are used as raw materials in the manufacture of chemicals and fertilizers, lubricants, greases, asphalts, coatings and similar products. The miscellaneous portion includes both energy and non-energy unaccounted for items."[42]

The NPC Gas Task Group defines "raw material and other" natural gas demand as the quantities of gas remaining after the fuel uses of natural gas in all markets are subtracted from total requirements. This category includes "field use", defined as gas consumed as fuel on leases for pumping, drilling, and other field facilities; quantities vented and flared on producing properties; and fuel losses and extraction loss at gas processing plants. "Other" uses of natural gas includes pipeline fuel, company use, transmission loss, and unaccounted or unclassified gas use.[43]

Summing the individual fuel categories exceeds the nonenergy total of such use estimated by the NPC Coordinating Committee for the nonenergy usage of all fuels. It is difficult to see how the general nonenergy forecast made by the NPC can include the "field use" of natural gas. If it does, the contribution of natural gas exceeds the contribution of oil in both 1970 and 1975. Table V indicates the non-energy use totals. From Table V it can be seen that in 1970, the natural gas nonenergy use, including field use, is higher than the total of all NPC nonenergy fossil fuel use. Without field use of natural gas and nonenergy coal, the total fossil fuel estimates equal the NPC total fossil fuel estimates, though this is not the case in 1975, 1980 and 1985. It was concluded, therefore, that the basis for the NPC determination of total nonenergy fuel requirements was by means of some other factors. This lack of clarity of method precludes district projection of specific fuel requirements for the nonenergy sector.

TABLE V

Nonenergy Fuel Requirements

(10^{12} BTU's)

	Petroleum	Coal	Natural Gas		Total		
			with field use	without field use	with field use of natural gas	without field use of natural gas	NPC
1970	3119	150	3116	891	6385	4160	4058
1975	4053	156	3533	1027	7802	5296	5279
1980	5112	156	3457	1078	8725	6346	6705
1985	6363	156	3236	1158	9755	7677	8930

Sources:

Petroleum: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand **Task** Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 69.

Coal: Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, December 1972. Appendix B, Table 14. The nonenergy coal figures used in this study are an extrapolation of the trend from 1947 to 1970.

Natural gas: NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, pp. 9-10.

NPC: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 7.

The natural gas figures displayed here are not used in the current forecast due to the apparent inconsistencies with the NPC total demand projections.

FOOTNOTES

(1) Battelle Memorial Institute, Pacific Northwest Laboratories, A Review and Comparison of Selected United States Energy Forecasts, prepared for the Office of Science and Technology, December 1969.

(2) United States Senate, Committee on Interior and Insular Affairs, Survey of Energy Consumption, 92nd Congress, Second Session, 1972.

(3) Federal Power Commission, The 1970 National Power Survey, vols. I-IV, August 1971.

National Petroleum Council, U.S. Energy Outlook, December 1972, Volumes 1-2. (Also includes the earlier NPC publications: U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 1, July 1971, Volume 2, November 1971, and the series of individual Task Group Reports).

U.S. Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, December 1972.

National Economic Research Associates, Inc., Fuels for the Electric Utility Industry 1971-1985, A report to the Edison Electric Institute, August 1972.

(4) Future Requirements Committee, Future Gas Requirements of the United States, vols. 3-4, September, 1969 and October 1970.

(5) Federal Power Commission, "News Release," No. 19620, September 12, 1973, Table 6.

(6) National Petroleum Council, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 7.

(7) National Petroleum Council, "Gas Demand", U.S. Energy Outlook (Rev.), 1973, p. 10. Based on an FPC forecast, see Future Requirements Committee, Op. Cit., vol. 4, October 1971.

(8) Atomic Energy Commission, Nuclear Reactors Built, Being Built, or Planned in the United States as of June 30, 1972. Federal Power Commission, Bulk Power Supply Information, April 1, 1972.

(9) This is necessary because of the unavailability of commercial energy trends based on individual commercial energy forecasts.

(10) National Petroleum Council, "Gas Demand," Op. cit., p. 10.

(11) The methodology refers to 1975 and beyond. Estimates for 1970 are, for the most part, summations of data released by the NPC.

(12) National Petroleum Council, "Gas Demand," Ibid., p. 10.

(13) Future Requirements Committee, Op. Cit.

(14) National Petroleum Council, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985", U.S. Energy Outlook: An Interim Report, 1972, pp. 66 - 67.

(15) Coking coal is a high quality, low volatile metallurgical coal, with a property known as caking (coking). It must be low in sulfur content (under 1.5 percent and preferably well under 1.0 percent). A high content of fixed carbon is desirable (volatile matter content between 17.5 and 25.0 percent). Ash levels should be minimal (5.0 to 7.0 percent). The coal is carbonized for coke in blast furnace operations. It is also used for chemical derivatives and gas. Other uses of coking coal are in low and medium temperature carbonization processes, in water gas, and in other coal gasification processes.

(16) Compare Table I & IA in this study with NPC, U.S. Energy Outlook, Dec. 1972, p. 16, Table 3.

(17) Oil accounts for about 95 percent of the transportation energy demand, natural gas accounts for 4 percent.

(18) For conversion factors see Department of the Interior, U.S. Energy Fact Sheets by States and Regions, Feb. 1973, p. 4.

(19) See Appendix A.

(20) In this report a 5 to 7 year lead time for nuclear plant construction was assumed. This is not entirely in line with NPC estimates of lead times. See "Fuels for Electricity", U.S. Energy Outlook, 1973, p. 7. The NPC estimates a 7-7.5 year lead time for nuclear plant construction, which could represent an understatement of 1-2 years. Therefore, it is probable that the lead time for nuclear plants is understated by 3-4 years in this study.

(21) National Petroleum Council, "Fuels for Electricity", U.S. Energy Outlook, 1973, p. 53.

(22) The NPC used a conversion factor of 1000 BTU/CF. In this paper a conversion factor of 1031 BTU/CF was used. Therefore, the BTU estimates here differ from the NPC's, though the fuel unit measurements are the same.

(23) See Table A2-VII

(24) This demand estimate is that of the FRC. See Future Requirements Committee, Op. Cit.

(25) See Table IB.

(26) The 1980 level was based on the Federal Power Commission, Bulk Power Supply Information, April 1, 1972, released Sept. 14, 1972. A lead time for plant construction of 6 years was used. This is slightly below the commonly accepted 7 to 8 year lead times.

(27) Federal Power Commission, "Guidelines for the Growth of the Electric Power Industry," The 1970 National Power Survey, Part I, U.S. Govt. Printing Office, Washington, Dec. 1971.

Federal Power Commission, Bulk Power Supply Information, April 1, 1972.

Atomic Energy Commission, Nuclear Reactors Built, Being Built, or Planned in the United States as of June 30, 1972.

(28) Atomic Energy Commission, Op. Cit.

(29) Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, December 1972, p. 26.

(30) Atomic Energy Commission, Nuclear Reactors Built, Being Built, or Planned in the United States as of June 30, 1972. This data is not the same as the AEC forecasts. See the testimony of Roger Le Gassie, Deputy Director, Office of Planning and Analysis, AEC, in Hearings before the Joint Committee on Atomic Energy, 93rd Congress, July 31 and August 1, 1973, "Future Structure of the Uranium Enrichment Industry," Part I, Phase I, Government Witnesses, p. 49. Mr. Le Gassie states "...We began a number of years ago not to use the utilities' statement of when a power plant was going to come on line but instead, to make an adjustment of that statement, using our evaluation of the situation and expecting some delay from the offical schedule."

(31) The bulk of the industry is made up of the following contractors: General Electric, Westinghouse Electric, Combustion Engineering, Babcock & Wilcox, Gulf General Atomic.

(32) Atomic Energy Commission, Nuclear Reactors Built, Being Built, or Planned in the United States as of June 30, 1972.

(33) Federal Power Commission, Bulk Power Supply Information, April 1, 1972 and 1973.

(34) Atomic Energy Commission, Nuclear Reactors Built, Being Built, or Planned in the United States as of June 30, 1972, compared to Ibid., December 31, 1970.

(35) Federal Power Commission, Bulk Power Supply Information, April 1, 1972.

(36) This load factor and this heat rate were both used to maintain consistency with the BOM factors used in 1975 and 1980. They are different from the 1975 and 1980 factors since the BOM reports different factors for 1985 than for 1975 and 1980. See: Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, December 1972, p. 26.

(37) Allowing petroleum to swing hinges on at least four assumptions concerning coal demand: (1) Due to pollution control regulations, it is expected that coal will not be used on a larger scale than its use at present. (2) Emission control devices are expected to be operable by 1980, but implementation will be slow as retro-fitting will not take place immediately. (3) A ban on stripmining and/or delays in the opening of new coal mines may further restrict coal usage. (4) Petroleum imports will increase if fuel shortages occur.

(38) Excluding PAD District V. See Table A2-V.

(39) See Table III.

(40) National Petroleum Council, "An Initial Appraisal by the Oil Demand Task Group, 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 111, 112. See also Table A1-XXVI of this report.

(41) Department of the Interior, U.S. Energy Fact Sheets by States and Regions, Feb. 1973, p. 4.

(42) National Petroleum Council, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 1, July 1971, p. 11.

(43) National Petroleum Council, "Gas Demand," U.S. Energy Outlook, 1973, pp. 8-11.

APPENDIX A: FUEL DEMAND BY DISTRICT AND MARKET

I. Petroleum

Table A1-I is a summary of petroleum demand by market sector and PAD district in terms of fuel units. Petroleum demand in the residential/commercial, transportation, and electric utility markets is derived from Tables A1-II through A2-XXVII. Demand in the industrial and non-energy markets is calculated from direct conversion of NPC data.(1) In comparison with the NPC petroleum forecasts the current petroleum demand forecasts are expected to exceed that of the NPC by 4.2, 7.3 and 15.8 percent in 1975, 1980 and 1985, respectively.

A. Residential/Commercial

Table A1-II shows the estimated petroleum demand in the residential/commercial market. The four major petroleum products are liquefied petroleum gas, kerosine, distillate oil and residual fuel oil. These are listed by PAD district. The table shows, for each product, the expected demand by year and the BTU distribution of fuel utilization assumed by the NPC.(3) The assignment of products by this process may be somewhat distorting because, in this study, any reduction in the demand of non-petroleum fuels is assumed to be offset by increased petroleum demand. This is a general assumption, one which does not differentiate among petroleum products. It is not altogether reasonable to expect a decrease in natural gas demand to cause an increase in both residual fuel oil and distillate fuel oil demand in the same proportion. Given the BOM petroleum conversion figures, this product inconsistency does not seriously affect total petroleum demand.

The following route was used in deriving Table A1-II from the BTU petroleum estimates found in Table I. First, the 1970 NPC petroleum demand was accepted. Then, the NPC petroleum demand estimates, in BTU's,(4) were weighted by product, using barrel/year weights, by PAD districts for the remaining years 1975, 1980 and 1985. The weighted comparison of each product to the total petroleum demand is shown on a percentage basis in Table A1-IV. Third, using the estimate of total petroleum demand for this market, the product breakdown in BTU's was calculated using the derived weighted averages. Product demand in

BTU's is presented in Table A1-III. Fourth, from the BTU product demand estimates thus derived, the following BOM conversion estimates[5] were used to arrive at product and total petroleum estimates in fuel units (millions of barrels per year).

liquefied petroleum gas	4,011,000 BTU/barrel
kerosine	5,670,000 BTU/barrel
distillate fuel oil	5,825,000 BTU/barrel
residual fuel oil	6,287,000 BTU/barrel

B. Transportation

Tables A1-V, IX, XIII, XVII and XXI give petroleum product demand figures for the transportation market. Each table represents one PAD district. As in the residential/commercial market, NPC data were used for weighting product demand before deriving demand estimates for each product from total petroleum demand forecasts. In reverse order to the presentation of the tables, first product demand in BTU's was calculated using the BOM's conversion factors. Second, the percentage of total BTU demand for each product was recorded. From the total petroleum demand estimates, individual product demand was determined using these percentage results. Finally, product demand in BTU's was converted into fuel units.

The BOM conversion factors used were:[2]

motor gasoline	5,248,000 BTU/barrel
aviation gasoline	5,248,000 BTU/barrel
naphtha jet	5,355,000 BTU/barrel
kerosine jet	5,670,000 BTU/barrel
distillate	5,825,000 BTU/barrel
kerosine	5,670,000 BTU/barrel
liquefied petroleum gas	4,011,000 BTU/barrel
residual, bunkers	6,287,000 BTU/barrel

C. Electric Utility

Table A1-XXV presents the electric utility petroleum product fuel demand in terms of barrels/year. These figures are an outgrowth of demand estimates made in terms of BTU's in Table A1-XXVI using conversion rates of 6,287,000 BTU/barrel for residual fuel oil and 5,825,000 BTU/barrel for distillate fuel oil.

The methodology employed was that of calculating petroleum demand as the residual of market demand after all other fuel demands had been established. Product demand was then distributed using the source

percentage of total petroleum forecast by the NPC. The percentage breakdown of product demand is presented in Table A1-XXVII.

Total national demand for petroleum in the electric utility market is forecast to expand seven-fold from 332 million barrels/year in 1970 to 2410 million barrels/year in 1985. The significance of this can be traced to the unfolding inability of the electric utilities to meet the previously accepted highly optimistic AEC estimates of nuclear capacity growth.

D. Industrial and Nonenergy

The petroleum estimates of demand forecast in this study are exactly those forecast by the NPC. The estimates are given in Table I and IA.

II. Coal Demand by Market

An overall view of coal demand in fuel units is shown in Table A2-I. This table is the resultant of initial coal estimates in BTU's subject to the following conversion factors.(6)

Conversion Factors
(BTU's/Short Ton)

Market	1970	1975-1985
Residential/Commercial	26,500,000	28,000,000
Electric utility	24,000,000	22,600,000
Nonenergy	27,000,000	27,000,000

In order to establish a regional demand level for coal, it was first necessary to estimate regional shipments of coal into specific markets. Though distribution of coal is not the same as demand for

coal, simple demand/supply arguments suggest that the distribution of coal by district on a percentage basis should approximate the percentage demand for coal in each district. Shipments of bituminous coal and lignite into five markets are shown in Table A2-II.[7] The table is divided into two sections. The first shows coal shipments in terms of millions of tons while the second indicates the distribution of coal, on a percentage basis, to individual consumers within each PAD district. Data collected under the classifications "retail dealers" and "others" in the first section correspond respectively to the data shown under the headings "residential/commercial" and "industrial" in section two.

The years 1969-1972 were used as a somewhat unsatisfactory base from which to project shipment trends. Although the base is limited, it was used nevertheless because the inclusion of previous years results in large distortions due to recent pollution control regulations.

The coal estimate is based on the NPC and BOM national estimates disaggregated to regional projections.[8] It should be noted that the regional forecasts of coal demand depend on both the extrapolation of specific distribution estimates and on current pollution (and general coal use) controls.

Using the historical coal distribution data published by the BOM found in Table A2-II, the 1970 percentage relationships among PAD districts in the residential/commercial market sector were calculated. A percentage relationship among PAD districts was then forecast over five-year intervals from 1975-1985. From this, using the national coal demand forecasts made by the BOM,[9] PAD district coal demand estimates for the years 1970, 1975, 1980 and 1985 were determined. These steps are shown in reverse order in Table A2-III.

Because of the uncertainty of pollution control regulation and enforcement, technological advances in coal sulfur emission control, and expected volume decreases in total coal consumption, district shares of coal consumption in the residential/commercial market are forecast to be constant from 1975 to 1985. Due to the shrinkage in expected demand the estimated error is small, though it may be large in percentage shares.

Industry demand for coal is presented in Table A2-IV. The estimates exclude coking coal, a form of coal highly dependent on steel industry demand.[10]

A demand trend was established by considering coal shipments over a recent time period and deriving an initial trend which could be extended through the year 1985. The shipment figures indicated in Table A2-II for the class of receivers called "others" serves as a rough approximation of district demands for industrial coal.[11]

As reflected by the BOM data,[12] the industrial market demand for coal declined during the period 1966 to 1970. In 1970 a reversal took place. The NPC chose, "in the interest of conservation,"[13] to ignore this reversal and projected a decrease in industrial coal demand by 12 percent over the 1970-1985 period. In this report, the potential demand for coal is assumed to remain constant through 1985.[14]

Table A2-V shows comparative fossil fuel consumption in the electric utility market. Past data are based on National Coal Association estimates.[15] Forecast comparisons are based on extrapolated estimates of the fuel mix. The comparisons are in percentage terms. They were used to determine coal consumption in conjunction with FRC natural gas projections.[16]

The NPC Coal Task Group projects a decrease in the national share of natural gas demand in the electric utility market of 13 percent from 1970 to 1985.[17] This projection reflects the NPC assumption that declining gas availability for this low priority market will result in increased coal demand.[18] Further, oil demand is assumed to be restricted to areas reached by imported residual oil.[19] This will cause coal demand to increase.

In this study no supply restriction is placed on demand. This implies that a pending natural gas supply shortage does not change the natural gas demand picture nor is an oil supply limitation transformed into a decreased oil demand. As a result, the coal demand estimates in this study are much lower than the coal demand forecast by the NPC.[20] Furthermore, the NPC assumed that increases in coal demand would occur if a shortfall in nuclear supply occurred. In this report oil, not coal, meets this shortfall. Oil therefore represents a swing fuel and

a much higher estimate is correspondingly projected here than that projected by the NPC.

Hence, in the forecast of fuel use by electric utilities, natural gas is projected with a constant market share in all districts except PAD District V.(22) The natural gas demand in District V is forecast to decrease by one percent yearly from 1970 to 1985.(23) This follows a trend established in 1966 and differs from the NPC projections.

The relative market share of coal is expected to decrease in PAD Districts I, II and III, increase in PAD District IV, and remain insignificant in PAD District V. In PAD District I, the decrease is at a yearly rate of five percent of the total fossil fuel consumption from 1970 to 1975, two percent a year from 1975 to 1980 and show no change from 1980 to 1985. In the remaining PAD districts, the change is less than one percent annually. The large changes in PAD District I are accounted for by stricter pollution controls on emissions from coal fired facilities, increased transportation costs for coal, increased oil refinery capacity, and projected increases in oil importation on the east coast. It was from this table and the NPC natural gas estimates that coal demand was determined in the electric utility sector.(24)

Tables A2-VI and VII show electric utility coal demand in 1970, 1975, 1980 and 1985, respectively. The 1970 data are those published by the National Coal Association.(25) The 1975-1985 data are derived from the natural gas estimates applied to the district shares of natural gas shown in Table A2-V. Thus, from the natural gas estimates, a total fossil fuel demand estimate was forecast. Reapplication of Table A2-V, using the coal share of estimated market demand compared to the estimated total fossil fuel demand produced the coal estimates shown in Tables A2-VI and A2-VII.

III. Natural Gas

Natural gas estimates were based on NPC data which, in turn, is based on estimates made by the FRC. In the BTU forecast, the NPC BTU figures were used in all markets except that of electric utilities. This divergence in the electric utility forecast is not due to different fuel unit estimates but, rather, to conversion factors. In the interval between the NPC's 1973 natural gas demand forecast and

their earlier forecast, the FRC published electric utility natural gas demand estimates. In the present study, the natural gas forecasts of the FRC were converted into BTU's using a 1031 BTU/cubic foot conversion factor which accords with BOM practice. The NPC converted the FRC data, in all markets, using a factor of 1000 BTU/cubic feet.

Table A3-I shows that the NPC expects the Nation's natural gas demand to almost double from 1970 to 1985. This doubling is uniform among all markets except non-energy, where demand is forecast to vary slightly. Tables A3-II and A3-III compare gas demand estimates made by the NPC in 1973 with their older estimates made in 1971. The new forecasts were based on a new set of forecasts made by the FRC (1971).(26) The old NPC forecast relied on a 1969 FRC publication.(27) Comparison of the two NPC forecasts were made on an absolute and percentage basis, showing the changes by market, district and year. The units of measurement are BTU's.

FOOTNOTES: APPENDIX A

(1) NPC, "An Initial Appraisal by the Oil Demand Task Group, 1971-1985", U.S. Energy Outlook: An Interim Report, 1972, pp. 67-70.

(2) Department of the Interior, U.S. Energy Fact Sheets by States and Regions, February 1973, p. 4.

(3) NPC, Op. Cit., pp. 58-64.

(4) Ibid.

(5) Department of the Interior, Op. Cit., p. 4.

(6) Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, December 1972, Appendix B, Tables 12, 13, 14, 25, 26. Department of the Interior, U.S. Energy Fact Sheets by States and Regions, February 1973, p. 4. The conversion process in the industrial market was avoided because projections were originally made in fuel units. See Table A2-IV.

(7) The distribution recorded by the BOM is by state. This was aggregated to a PAD district basis. Anthracite distribution and trends were not studied separately but were included in the total coal demand estimates. The quantity of anthracite consumption projected was not considered sufficient to warrant an individual analysis. Its consumption is limited, primarily going to PAD District I.

(8) See Tables A2-I, III, and IV.

(9) See Appendix D. BOM data was used in place of the NPC data because of the consistency resulting from the utilization of coal distribution figures published by the BOM. See also NPC, U.S. Energy Outlook: Coal Availability, 1972, pp. 90-91 for comparison.

(10) This is a normal practice except that coking coal demand is later added into the energy demand figures. In this report, the NPC coking coal demand estimates have been subtracted from the NPC total energy demand figures.

(11) The class "others" includes raw materials but serves as a rough approximation since no other category could conceivably represent industrial coal adequately. Further, this class excludes coal distribution to coke and gas plants.

(12) See Table A2-II and NPC, U.S. Energy Outlook: Coal Availability, 1973, p. 90.

(13) NPC, U.S. Energy Outlook: Coal Availability, 1973, p. 90.

(14) The decline projected by the NPC is less than one percent per year, and in terms of absolute coal demand is not very different than the industrial demand projected in this study.

(15) National Coal Association, Steam Electric Plant Factors, Washington 1966, 1968, 1971 and 1972 editions, pp. 46, 50 and 52, respectively.

(16) The FRC natural gas demand was adopted by the NPC Gas Demand Task Group (see NPC, U.S. Energy Outlook: Gas Demand, 1973, p. 10) but not by the Coal Demand Task Group (see NPC, U.S. Energy Outlook: Coal Availability, 1973, p. 101, Table E-12).

(17) NPC, U.S. Energy Outlook: Coal Availability, 1973, p. 101.

(18) Ibid., p. 100.

(19) Idem.

(20) See Table A2-VI and VII versus NPC, U.S. Energy Outlook: Coal Availability, 1973, p. 103.

(21) Ibid., p. 90.

(22) That is, relative to coal and oil.

(23) I.e., a decrease of 18 percent is forecast over the period from 1970 to 1985.

(24) Refer to Table A2-VII.

(25) NCA, Steam Electric Plant Factors, February 1972, pp. 51-52.

(26) Future Requirments Committee, Future Gas Requirements of the United States, Volume No. 4, Future Requirements Agency, Denver Research Institute, University of Denver, Denver, Colorado, October 1971.

(27) Future Requirements Committee, Future Gas Requirements of the United States, Volume No. 3, Future Requirements Agency, Denver Research Institute, University of Denver, Denver, Colorado, September 1969.

TABLE A1-I

U.S. Petroleum Requirements
by PAD District and Consuming Sector for Selected Years

(10^6 B/Yr)

	1970	1975	1980	1985
PAD District I				
Residential/Commercial	550	597	623	647
Industrial	177	218	274	337
Transportation	1,024	1,249	1,491	1,761
Electric Utilities	286	615	973	1,327
Non-Energy	106	129	175	227
Total:	2,143	2,808	3,536	4,299
PAD District II				
Residential/Commercial	279	332	355	395
Industrial	155	190	237	276
Transportation	929	1,104	1,315	1,539
Electric Utilities	14	41	74	278
Non-Energy	124	159	196	238
Total:	1,501	1,826	2,177	2,726
PAD District III				
Residential/Commercial	56	85	95	116
Industrial	117	132	156	239
Transportation	364	435	517	606
Electric Utilities	1	28	115	184
Non-Energy	289	395	502	634
Total:	827	1,075	1,385	1,779
PAD District IV				
Residential/Commercial	20	24	27	43
Industrial	21	28	36	44
Transportation	90	109	131	162
Electric Utilities	2	8	32	55
Non-Energy	15	18	21	25
Total:	148	187	247	329
PAD District V				
Residential/Commercial	46	58	63	71
Industrial	79	103	121	142
Transportation	502	643	784	950
Electric Utilities	29	132	351	589
Non-Energy	49	64	79	97
Total:	705	1,000	1,398	1,849
U.S. Total:	5,324	6,896	8,743	10,982

Sources: Tables A1-III, -V, -IX, -XIII, -XVIII and -XXI; and NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 67-70.

TABLE A1-II

Residential/Commercial Requirements
for Petroleum Fuels
(10^6 B/Yr)

	1970	1975	1980	1985
PAD District I				
LPG	33	41	46	50
Kerosine	40	37	33	29
Distillate	334	360	381	403
Residual	143	159	163	165
Total:	550	597	623	647
PAD District II				
LPG	89	119	131	151
Kerosine	24	23	22	21
Distillate	142	159	167	182
Residual	24	31	35	41
Total:	279	332	355	395
PAD District III				
LPG	44	67	77	94
Kerosine	7	9	7	7
Distillate	4	8	9	13
Residual	1	1	2	2
Total:	56	85	95	116
PAD District IV				
LPG	8	10	11	18
Kerosine	1	1	1	1
Distillate	8	10	12	19
Residual	3	3	3	5
Total:	20	24	27	43
PAD District V				
LPG	11	14	16	19
Kerosine	1	1	1	1
Distillate	24	30	33	37
Residual	10	13	13	14
Total:	46	58	63	71

Source: Table A1-III using the conversion factors listed in the introductory note to this section of Appendix A1.

TABLE A1-III

Residential/Commercial Requirements

for Petroleum Fuels

(10^{12} BTU's)

	1970	1975	1980	1985
PAD District I				
LPG	132	166	184	199
Kerosine	228	208	188	165
Distillate	1,945	2,095	2,220	2,359
Residual	902	1,001	1,027	1,039
Total:	3,207	3,470	3,619	3,752
PAD District II				
LPG	356	477	524	605
Kerosine	137	133	123	121
Distillate	829	927	975	1,063
Residual	149	192	219	255
Total:	1,471	1,729	1,841	2,044
PAD District III				
LPG	176	268	308	376
Kerosine	42	49	42	41
Distillate	26	45	55	73
Residual	4	9	12	15
Total:	248	371	417	505
PAD District IV				
LPG	32	40	46	73
Kerosine	8	6	4	3
Distillate	49	60	68	109
Residual	16	18	20	31
Total:	105	124	138	216
PAD District V				
LPG	43	57	65	76
Kerosine	4	5	5	6
Distillate	138	177	193	214
Residual	67	84	84	86
Total:	252	323	347	382

Source: Table I and the distribution assumptions found in Table A1-IV; see NPC, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 60-64.

TABLE A1-IV

Distribution of Petroleum Fuels in the
Residential/Commercial Market by PAD District

(percent)

	1975	1980	1985
PAD District I			
LPG	4.8	5.1	5.3
Kerosine	6.0	5.2	4.4
Distillate	60.4	61.4	62.6
Residual	28.9	28.4	27.7
PAD District II			
LPG	27.6	28.4	29.6
Kerosine	7.7	6.7	5.9
Distillate	53.6	52.9	52.0
Residual	11.1	11.9	12.5
PAD District III			
LPG	72.4	74.0	74.5
Kerosine	13.1	10.1	8.0
Distillate	12.0	13.1	14.5
Residual	2.5	2.8	3.0
PAD District IV			
LPG	32.3	33.1	33.8
Kerosine	4.8	2.8	1.2
Distillate	48.4	49.3	50.6
Residual	14.5	14.8	14.4
PAD District V			
LPG	17.7	18.9	19.9
Kerosine	1.5	1.5	1.5
Distillate	54.7	55.5	56.0
Residual	26.0	24.1	22.6

Source: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 59-64.

Percentages may not sum to 100 due to rounding.

TABLE A1-V

Transportation Requirements

for Petroleum Products

PAD District I

(10^6 B/Yr)

	1970	1975	1980	1985
Motor Gasoline	788	909	1,047	1,175
Aviation Gasoline	5	4	5	7
Naphtha Jet	27	23	21	21
Kerosine Jet	110	171	250	345
Distillate	48	91	111	126
Kerosine-Highway		1	4	17
LPG & LNG Internal Combustion	3	5	10	17
Residual Bunkers	43	45	43	53
Total:	1,024	1,249	1,491	1,761

Demand estimates are the result of applying the conversion factors listed in the introductory note to this section of Appendix A1 and Table A1-VI.

TABLE A1-VI

Transportation Requirements

for Petroleum Products

PAD District I

(10^{12} BTU's)

	1970	1975	1980	1985
Motor Gasoline	4,137	4,769	5,497	6,166
Aviation Gasoline	27	20	24	37
Naphtha Jet	142	121	112	112
Kerosine Jet	625	969	1,417	1,955
Distillate	279	532	644	730
Kerosine-Highway		7	24	94
LPG & LNG Internal Combustion	10	20	40	65
Residual Bunkers	268	282	298	332
Total:	5,488	6,720	8,057	9,491

Demand estimates are the result of applying the distribution assumptions of Table A1-VII to the derived total petroleum demand estimates found in Table I.

TABLE A1-VII

Distribution of Petroleum Product Demand
in the Transportation Market
PAD District I

(Percent)

	1970	1975	1980	1985
Motor Gasoline	75.4	70.9	68.2	65.0
Aviation Gasoline	.5	.3	.3	.4
Naphtha Jet	2.6	1.8	1.4	1.2
Kerosine Jet	11.4	14.4	17.6	20.6
Distillate - vessels				
Distillate - railroad				
Distillate - highway				
Distillate - total	5.1	7.9	8.0	7.7
Kerosine - highway		.1	.3	1.0
LPG & LNG Internal Combustion	.2	.3	.5	.7
Residual Bunkers	4.9	4.2	3.7	3.5

Source: Table A1-VIII

Percentages may not sum to 100 due to rounding.

TABLE A1-VIII

NPC Projections of Petroleum Product Demand
in the Transportation Market

PAD District I
(10^{12} BTU's)

	1970	1975	1980	1985
Motor Gasoline	3,837	4,597	5,402	6,015
Aviation Gasoline	25	21	27	36
Naphtha Jet	131	117	113	109
Kerosine Jet	579	933	1,391	1,908
Distillate	259	515	631	712
Kerosine - Highway		6	23	89
LPG & LNG Internal Combustion	12	22	37	66
Residual Bunkers	248	273	296	321
Total:	5,091	6,484	7,920	9,256

Source: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 89, with the conversion factors listed in the introductory note in this section of this Appendix.

TABLE A1-IX

Transportation Requirements

for Petroleum Products

PAD District II

(10^6 B/Yr)

	1970	1975	1980	1985
Motor Gasoline	753	878	1,018	1,154
Aviation Gasoline	5	3	5	6
Naphtha Jet	16	14	13	12
Kerosine Jet	57	89	129	178
Distillate	86	102	122	141
Kerosine - Highway		1	5	16
LPG & LNG Internal Combustion	10	15	21	31
Residual Bunkers	2	2	2	1
Total:	929	1,104	1,315	1,539

Demand estimates are the result of applying the conversion factors listed in the introductory note to this section of this Appendix and Table A1-X.

TABLE A1-X

Transportation Requirements

for Petroleum Products

PAD District II

(10^{12} BTU's)

	1970	1975	1980	1985
Motor Gasoline	3,952	4,612	5,343	6,054
Aviation Gasoline	25	18	28	33
Naphtha Jet	83	77	71	66
Kerosine Jet	319	505	732	1,011
Distillate	496	599	712	823
Kerosine - Highway		6	28	91
LPG & LNG Internal Combustion	40	59	85	124
Residual Bunkers	10	12	14	8
Total:	4,926	5,888	7,013	8,210

Demand estimates are the results of applying the distribution assumptions of Table A1-XI to the derived total petroleum demand estimates found in Table I.

TABLE A1-XI

Distribution of Petroleum Product Demand
in the Transportation Market

PAD District II
(Percent)

	1970	1975	1980	1985
Motor Gasoline	80.3	78.4	76.2	73.7
Aviation Gasoline	.5	.3	.4	.4
Naphtha Jet	1.7	1.3	1.0	.8
Kerosine Jet	6.5	8.6	10.5	12.3
Distillate - Vessels				
Distillate - Railroad				
Distillate - Highway				
Distillate - Total	10.1	10.2	10.2	10.0
Kerosine - Highway		.1	.4	1.1
LPG & LNG Internal Combustion	.8	1.0	1.2	1.5
Residual Bunkers	.2	.2	.2	.1

Source: Table A1-XII

Percentages may not sum to 100 due to rounding.

TABLE A1-XII

NPC Projections of Petroleum Product Demand
in the Transportation Market

PAD District II

(10^{12} BTU's)

	1970	1975	1980	1985
Motor Gasoline	3,879	4,607	5,430	6,091
Aviation Gasoline	23	19	27	34
Naphtha Jet	82	74	70	66
Kerosine Jet	314	503	747	1,020
Distillate	487	597	725	829
Kerosine - Highway		6	27	93
LPG & LNG Internal Combustion	38	56	88	124
Residual Bunkers	9	11	11	11
Total:	4,832	5,873	7,125	8,268

Source: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 92, with the conversion factors listed in the introductory note to this section of this Appendix.

TABLE A1-XIII

Transportation Requirements

for Petroleum Products

PAD District III

(10^6 B/Yr)

	1970	1975	1980	1985
Motor Gasoline	248	299	353	404
Aviation Gasoline	5	4	5	7
Naphtha Jet	12	10	10	9
Kerosine Jet	19	30	45	63
Distillate	36	44	54	62
Kerosine - Highway		1	1	6
LPG & LNG Internal Combustion	23	25	26	29
Residual Bunkers	21	22	23	25
Total:	364	435	517	606

Demand estimates are the result of applying the conversion factors listed in the introductory note to this section of this Appendix and Table A1-XIV

TABLE A1-XIV

Transportation Requirements

for Petroleum Products

PAD District III

(10^{12} BTU's)

	1970	1975	1980	1985
Motor Gasoline	1,302	1,568	1,854	2,122
Aviation Gasoline	27	21	25	36
Naphtha Jet	63	56	52	49
Kerosine Jet	106	172	256	358
Distillate	208	256	313	358
Kerosine - Highway		5	8	36
LPG & LNG Internal Combustion	91	99	105	117
Residual Bunkers	129	137	144	154
Total:	1,926	2,314	2,757	3,230

Demand estimates are the result of applying the distribution assumptions of Table A1-XV to the derived total petroleum demand estimates found in Table I.

TABLE A1-XV

Distribution of Petroleum Product Demand
in the Transportation Market
PAD District III

(Percent)

	1970	1975	1980	1985
Motor Gasoline	67.6	67.9	67.1	65.7
Aviation Gasoline	1.4	.9	.9	1.1
Naphtha Jet	3.3	2.4	1.9	1.5
Kerosine Jet	5.5	7.4	9.3	11.1
Distillate - Vessels				
Distillate - Railroad				
Distillate - Highway				
Distillate - Total	10.8	11.0	11.3	11.1
Kerosine - Highway		.2	.3	1.1
LPG & LNG Internal Combustion	4.7	4.3	3.8	3.6
Residual Bunkers	6.7	5.9	5.2	4.8

Source: Table A1-XVI

Percentages may not sum to 100 due to rounding.

TABLE A1-XVI

NPC Projections of Petroleum Product Demand
in the Transportation Market
PAD District III
(10^{12} BTU's)

	1970	1975	1980	1985
Motor Gasoline	1,404	1,723	2,069	2,375
Aviation Gasoline	29	23	29	38
Naphtha Jet	68	62	59	55
Kerosine Jet	114	188	288	401
Distillate	225	279	349	402
Kerosine - Highway		4	10	41
LPG & LNG Internal Combustion	97	108	117	129
Residual Bunkers	140	149	161	172
Total:	2,077	2,536	3,082	3,613

Source: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 93, with the conversion factors listed in the introductory note to this section of this Appendix.

TABLE A1-XVII

Transportation Requirements
for Petroleum Products
PAD District IV
(10^6 B/Yr)

	1970	1975	1980	1985
Motor Gasoline	65	76	86	101
Aviation Gasoline	1	1	1	2
Naphtha Jet	2	2	2	2
Kerosine Jet	8	12	19	26
Distillate	13	16	20	24
Kerosine - Highway				2
LPG & LNG Internal Combustion	1	2	3	5
Residual Bunkers				
Total:	90	109	131	162

Demand estimates are the result of applying the conversion factors listed in the introductory note to this section of this Appendix and Table A1-XVIII.

TABLE A1-XVIII

Transportation Requirements
for Petroleum Products
PAD District IV
(10^{12} BTU's)

	1970	1975	1980	1985
Motor Gasoline	339	401	453	528
Aviation Gasoline	4	4	6	10
Naphtha Jet	13	13	12	10
Kerosine Jet	43	69	101	146
Distillate	75	91	116	137
Kerosine - Highway			2	9
LPG & LNG Internal Combustion	4	7	12	19
Residual Bunkers				
Total:	478	585	702	859

Demand estimates are the result of applying the distribution assumptions of Table A1-XIX to the derived total petroleum demand estimates found in Table I.

TABLE A1-XIX

Distribution of Petroleum Product Demand
in the Transportation Market

PAD District IV

(Percent)

	1970	1975	1980	1985
Motor Gasoline	71.0	68.5	64.5	61.5
Aviation Gasoline	.9	.7	.9	1.2
Naphtha Jet	2.8	2.3	1.7	1.2
Kerosine Jet	8.9	11.8	14.5	17.0
Distillate - Vessels				
Distillate - Railroad				
Distillate - Highway				
Distillate - Total:	15.6	15.5	16.5	16.0
Kerosine - Highway			.3	1.0
LPG & LNG Internal Combustion	.9	1.2	1.7	2.2
Residual Bunkers				

Source: Table A1-XX

Percentages may not sum to 100 due to rounding.

TABLE A1-XX

NPC Projections of Petroleum Product Demand
in the Transportation Market
PAD District IV
(10^{12} BTU's)

	1970	1975	1980	1985
Motor Gasoline	328	393	450	517
Aviation Gasoline	4	4	6	10
Naphtha Jet	13	13	12	10
Kerosine Jet	41	68	101	143
Distillate	72	89	115	134
Kerosine - Highway			2	8
LPG & LNG Internal Combustion	4	7	12	18
Residual Bunkers				
Total:	462	574	698	840

Source: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 94, with the conversion factors listed on the introductory note to this section of this Appendix.

TABLE A1-XXI

Transportation Requirements

for Petroleum Products

PAD District V

(10^6 B/Yr)

	1970	1975	1980	1985
Motor Gasoline	320	388	450	506
Aviation Gasoline	5	5	6	8
Naphtha Jet	35	31	30	29
Kerosine Jet	80	130	192	269
Distillate	42	54	66	78
Kerosine - Highway		1	2	8
LPG & LNG Internal Combustion	1	3	6	18
Residual Bunker	29	31	32	34
Total:	502	643	784	950

Demand estimates are the result of applying the conversion factors listed in the introductory note to this section of this Appendix and Table A1-XXII.

TABLE A1-XXII

Transportation Requirements

for Petroleum Products

PAD District V

(10^{12} BTU's)

	1970	1975	1980	1985
Motor Gasoline	1,681	2,037	2,360	2,658
Aviation Gasoline	25	24	34	41
Naphtha Jet	189	164	158	154
Kerosine Jet	453	739	1,090	1,523
Distillate	244	314	387	452
Kerosine - Highway		3	9	46
LPG & LNG Internal Combustion	3	14	26	72
Residual Bunkers	181	192	200	214
Total:	2,776	3,487	4,264	5,160

Demand estimates are a result of applying the distribution assumptions of Table A1-XXIII to the derived total petroleum demand estimates found in Table I.

TABLE A1-XXIII

Distribution of Petroleum Product Demand
in the Transportation Market
PAD District V

(Percent)

	1970	1975	1980	1985
Motor Gasoline	60.5	58.4	55.4	51.5
Aviation Gasoline	.9	.7	.8	.8
Naphtha Jet	6.8	4.7	3.7	3.0
Kerosine Jet	16.3	21.2	25.6	29.5
Distillate - Vessels				
Distillate - Railroad				
Distillate - Highway				
Distillate - Total:	8.8	9.0	9.1	8.7
Kerosine - Highway		.1	.2	.9
LPG & LNG Internal Combustion	.1	.4	.6	1.4
Residual Bunkers	6.5	5.5	4.7	4.1

Source: Table A1-XXIV

Percentages may not sum to 100 due to rounding.

TABLE A1-XXIV

NPC Projections of Petroleum Product Demand
in the Transportation Market
PAD District V
(10^{12} BTU's)

	1970	1975	1980	1985
Motor Gasoline	1,634	1,992	2,356	2,624
Aviation Gasoline	25	25	33	42
Naphtha Jet	184	162	156	151
Kerosine Jet	441	724	1,089	1,502
Distillate	238	306	387	444
Kerosine - Highway		4	10	48
LPG & LNG Internal Combustion	4	12	25	73
Residual Bunkers	177	188	200	211
Total:	2,703	3,412	4,256	5,095

Source: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 94, with the conversion factors listed in the introductory note to this section of this Appendix.

TABLE A1-XXV

Electric Utility Petroleum Fuel Demand

(10^6 B/Yr)

	1970	1975	1980	1985
PAD District I				
Residual	269	568	887	1,216
Distillate	17	47	86	111
Total:	286	615	973	1,327
PAD District II				
Residual	8	27	55	212
Distillate	6	14	19	66
Total:	14	41	74	278
PAD District III				
Residual	1	16	77	136
Distillate	*	12	38	48
Total:	1	28	115	184
PAD District IV				
Residual	2	8	32	32
Distillate				
Total:	2	8	32	32
PAD District V				
Residual	28	129	334	570
Distillate	1	3	17	19
Total:	29	132	351	589
U.S. Total:	332	824	1545	2410

Sources: Table I and Tables A1-XXVI and A1-XXVII with the following conversion factors: residual fuel oil - 6,287,000 BTU/barrel and distillate fuel oil - 5,825,000 BTU/barrel.

*1970 distillate demand in PAD District III is less than 1 x 10^6 B/Yr.

TABLE A1-XXVI

Electric Utility Petroleum Fuel Demand

by PAD District

(10^{12} BTU's)

	1970	1975	1980	1985
PAD District I				
Residual	1694	3569	5579	7643
Distillate	99	273	498	647
Total:	1793	3842	6077	8290
PAD District II				
Residual	54	172	345	1331
Distillate	36	81	111	386
Total:	90	253	456	1717
PAD District III				
Residual	8	98	483	852
Distillate	2	73	220	277
Total:	10	171	703	1129
PAD District IV				
Residual	13	51	202	343
Distillate				
Total:	13	51	202	343
PAD District V				
Residual	178	810	2101	3582
Distillate	4	17	97	111
Total:	182	827	2198	3693

Source: Tables IA and A1-XXVII.

TABLE A1-XXVII

Distribution of Petroleum Fuel Demand

in the Electric Utility Market

by PAD District

(Percent)

	1970	1975	1980	1985
PAD District I				
Residual	94.5	92.9	91.8	92.2
Distillate	5.5	7.1	8.2	7.8
PAD District II				
Residual	59.5	68.0	75.7	77.5
Distillate	40.5	32.0	24.3	22.5
PAD District III				
Residual	81.8	57.5	68.7	75.5
Distillate	18.2	42.5	31.3	24.5
PAD District IV				
Residual	100.0	100.0	100.0	100.0
Distillate	-	-	-	-
PAD District V				
Residual	97.8	97.9	95.6	97.0
Distillate	2.2	2.1	4.4	3.0

Source: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985", U.S. Energy Outlook: An Interim Report, 1972, pp. 111, 112.

TABLE A2-I

Projections of Coal Demand by PAD District
and Consuming Sector for Selected Years

(10^6 T/Yr)

	1970	1975	1980	1985
PAD District I				
Residential/Commercial	2.9	2.9	2.7	.9
Industrial	27.5	21.2	21.2	21.2
Transportation				
Electric Utilities	111.3	77.4	54.2	61.9
Non-Energy	1.9	1.5	1.5	1.5
Total	143.6	103.0	79.6	85.5
PAD District II				
Residential/Commercial	10.9	7.0	6.4	2.1
Industrial	50.0	55.0	55.0	55.0
Transportation				
Electric Utilities	177.3	252.2	284.5	304.9
Non-Energy	3.4	3.7	3.7	3.7
Total	241.6	317.9	349.6	365.7
PAD District III				
Residential/Commercial	.1	.2	.2	.1
Industrial	2.3	4.2	4.2	4.2
Transportation				
Electric Utilities	22.3	26.1	30.5	39.8
Non-Energy	.1	.3	.3	.3
Total	24.1	30.8	35.2	44.4
PAD District IV				
Residential/Commercial	.8	1.2	1.1	.4
Industrial	1.5	2.5	2.5	2.5
Transportation				
Electric Utilities	8.0	10.8	12.6	15.5
Non-Energy	.1	.2	.2	.2
Total	10.4	14.7	16.4	18.6
PAD District V				
Residential/Commercial	.2	.4	.3	.1
Industrial	.3	1.7	1.7	1.7
Transportation				
Electric Utilities	.9	3.3	1.3	-
Non-Energy	-	.1	.1	.1
Total	1.4	5.5	3.4	1.9
U.S. Total	421.8	471.9	484.2	516.1
U.S. Total				
Residential/Commercial	14.9	11.7	10.7	3.6
Industrial	81.6	84.6	84.6	84.6
Transportation				
Electric Utilities	319.8	369.8	383.1	422.1
Non-Energy	5.5	5.8	5.8	5.8
Total	421.8	471.9	484.2	516.1

Source: Tables A2-IIA through VII.

TABLE A2-IIA

Coal Shipments by User for the Years 1969-1972, by PAD Districts

(10^6 T/Yr)

	PAD District				
	I	II	III	IV	V
Total					
1969	184.8	266.8	29.8	12	3.8
1970	186.2	283.0	34.3	13	3.4
1971	170.3	267.9	35.3	12.6	5.6
1972	177.9	294.9	37.9	14.9	9.1
Electric Utilities					
1969	110.8	166.3	18.6	7.1	1.1
1970	112.7	185.8	22.3	8.0	1.0
1971	110.7	185.9	24.5	8.5	3.3
1972	119.5	208.4	26.2	9.9	7.0
Coke and Gas Plants					
1969	41.2	36.6	9.1	2.8	2.1
1970	43.0	37.1	9.6	3.0	2.2
1971	34.7	33.1	8.1	2.7	1.8
1972	35.9	38.3	8.9	2.8	1.8
Retail Dealers					
1969	2.7	11.0	.1	.8	.2
1970	2.7	10.3	.1	.8	.2
1971	2.1	7.6	.1	.8	.3
1972	1.9	6.4	.1	.7	.2
Others					
1969	30.0	52.9	1.8	1.4	.3
1970	27.5	50.0	2.3	1.5	.3
1971	22.9	41.2	2.7	1.1	.6
1972	20.1	41.7	2.7	1.4	.6

Source: See sources Table A2-IIB.

TABLE A2-IIB

Coal Shipments in the Years 1969-1972 by
User by PAD District

(Percent)

	PAD District				
	I	II	III	IV	V
1969					
Electric Utilities	60.0%	62.3%	62.4%	59.2%	28.9%
Industrial	16.2	19.8	6.0	11.7	7.9
Coking Coal	22.3	13.7	30.5	23.3	55.3
Commercial/Residential	1.5	4.1	0.3	1.7	5.3
1970					
Electric Utilities	60.5	65.7	65.0	61.5	25.6
Industrial	14.8	17.7	6.7	11.5	8.8
Coking Coal	23.1	13.1	28.0	23.1	64.7
Commercial/Residential	1.5	3.6	0.3	5.4	5.1
1971					
Electric Utilities	65.0	69.4	69.4	67.5	58.9
Industrial	13.4	15.4	7.6	8.7	10.7
Coking Coal	20.4	12.4	23.0	21.4	32.1
Commercial/Residential	1.5	2.8	0.3	6.3	5.4
1972					
Electric Utilities	67.2	70.7	69.1	66.4	76.9
Industrial	11.3	14.1	7.1	9.4	6.6
Coking Coal	20.2	13.0	23.5	18.8	19.8
Commercial/Residential	1.1	2.2	0.3	4.7	2.2

Source: BOM, "Bituminous Coal & Lignite Distribution," Mineral Industry Surveys, 1969, 1970, 1971, 1972.

Percentages may not sum to 100 due to rounding.

TABLE A2-III
Residential/Commercial Coal Demand
by PAD District

(10^{12} BTU's)

	I	II	III	IV	V	Total
Current Forecast:						
1970	76	290	3	20	6	395
1975	81	195	6	33	10	325
1980	75	180	6	30	9	300
1985	25	60	2	10	3	100
Percentage Forecast:						
1970	19.3	73.6	.7	7.5	2.2	
1975	25	60	2	10	3	
1980	25	60	2	10	3	
1985	25	60	2	10	3	
Historical Percentage Trend:						
1969	18.2	74.3	.7	5.4	1.4	
1970	19.3	73.6	.7	5.0	1.4	
1971	19.3	69.7	.9	7.3	2.8	
1972	20.4	68.8	1.1	7.5	2.2	

Sources:

BOM, "Bituminous Coal & Lignite Distribution;" Mineral Industry Surveys, 1969, 1970, 1971, 1972.

Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, December 1972, p. 47.

The BOM's data classified as "Retail Dealers" corresponds to the current forecast's data under the classification "Residential/ Commercial Market."

TABLE A2-IV

Industrial Coal Demand for Selected Years 1970-1985

by PAD Districts

(10^6 T/Yr)

	I	II	III	IV	V	Total
1970	27.5	50.0	2.3	1.5	.3	81.6
1975	21.2	55.0	4.2	2.5	1.7	84.6
1980	21.2	55.0	4.2	2.5	1.7	84.6
1985	21.2	55.0	4.2	2.5	1.7	84.6

(10^{12} BTU's)

1970	715	1300	60	39	8	2122
1975	550	1430	110	66	44	2200
1980	550	1430	110	66	44	2200
1985	550	1430	110	66	44	2200

(Percentage of Total)

1970	33.7	61.3	2.8	1.8	.4
1975	25	65	5	3	2
1980	25	65	5	3	2
1985	25	65	5	3	2

Source:

Extrapolation from data in BOM, "Bituminous Coal & Lignite Distribution", Mineral Industry Surveys, 1969, 1970, 1971, 1972.

TABLE A2-V

Fossil Fuel Mix for the Electric Utility Market for Selected Years by PAD District

(Percent)

	Coal	Oil	Gas
PAD District I			
1966	74	19	7
1968	71	22	7
1970	56	33	11
1971	54	36	10
1975	30	60	10
1980	20	70	10
1985	20	70	10
PAD District II			
1966	85	--	15
1968	85	--	15
1970	80	--	20
1971	80	2	18
1975	77	3	20
1980	75	5	20
1985	75	5	20
PAD District III			
1966	25	--	75
1968	24	--	76
1970	22	--	78
1971	21	1	78
1975	20		80
1980	18	2	80
1985	18	2	80
PAD District IV			
1966	68	7	26
1968	70	6	24
1970	70	6	24
1971	67	7	26
1975	72	3	25
1980	72	3	25
1985	73	2	25
PAD District V			
1966	2	16	82
1968	2	15	83
1970	2	15	83
1971	4	22	74
1975	5	25	70
1980	2	33	65
1985	-	45	55

Source: National Coal Association, Steam Electric Plant Factors, 1966 Edition, p. 46; 1968 Edition, p. 50; 1971 Edition, p. 52; 1972 Edition, p. 52.

The 1975, 1980 and 1985 fuel mixes are extrapolations.

TABLE A2-VI

Electric Utility Coal Demand
in 1970

	(10^6 T/Yr)	(10^{12} BTU's)
PAD District I	111.3	2670.2
New England	3.5	85.0
Middle Atlantic	44.3	1066.7
South Atlantic	63.5	1518.5
PAD District II	177.3	3896.8
East North Central	117.7	2627.0
West North Central	26.3	530.6
Kentucky	18.2	396.9
Tennessee	15.1	342.3
PAD District III	22.3	489.4
Alabama	16.3	378.9
Mississippi	.5	11.8
New Mexico	5.5	98.7
West South Central	-	-
PAD District IV	8.0	150.2
PAD District V	.9	22.5
Total	319.8	7229

Source:

NCA, Steam Electric Plant Factors, Feb. 1972, pp. 51-52.

TABLE A2-VII

Electric Utility Coal Demand
by PAD District for the Years
1975, 1980 and 1985

(10^6 T/Yr)

		1975	1980	1985
PAD District	I	77.4	54.2	61.9
	II	252.2	284.5	304.9
	III	26.1	30.5	39.8
	IV	10.8	12.6	15.5
	V	3.3	1.3	-
U.S. Total		369.8	383.1	422.1

(10^{12} BTU's/Yr)

		1975	1980	1985
PAD District	I	1750	1225	1400
	II	5700	6430	6890
	III	590	690	900
	IV	245	285	350
	V	75	30	-
U.S. Total		8360	8660	9540

Sources:

Table A2-V and Table A3-I. A conversion factor of 1031 BTU/CF was used to determine natural gas demand. Coal demand was then estimated using the tables relative to natural gas demand. See discussion in text.

TABLE A3-I

NPC

Projected Annual Gas Requirments by Consuming Sector and PAD District for Selected Years 1970 Through 1985

(10^9 CF)

Use Category		PAD District I				PAD District II			PAD District III	PAD District IV	PAD District V	Total
		New England	Middle Atlantic	South Atlantic	Total	East North Central	All Other	Total				
1970	Residential/Commercial	177	1106	517	1800	2138	1059	3197	734	260	910	6901
	Industrial	52	578	654	1284	1494	984	2478	4140	238	897	9037
	Electric Utilities	9	172	324	505	272	699	971	1617	63	759	3915
	Transportation	5	33	27	65	144	108	252	305	10	57	689
	Raw Material & Other	8	91	110	209	265	445	710	1831	104	262	3116
	Total Inc. Field Use	251	1980	1632	3863	4313	3295	7608	8627	675	2885	23658
1975	Residential/Commercial	231	1347	682	2260	2664	1232	3896	848	310	1125	8439
	Industrial	77	862	1132	2071	2377	1322	3699	5284	298	1289	12641
	Electric Utilities	17	210	339	566	578	870	1448	2298	83	1068	5463
	Transportation	6	43	39	88	205	137	342	393	12	74	909
	Raw Material & Other	6	106	139	251	346	522	868	2079	115	220	3533
	Total Inc. Field Use	337	2568	2331	5236	6170	4083	10253	10902	818	3776	30985
1980	Residential/Commercial	287	1576	860	2723	3173	1424	4597	1011	349	1327	10007
	Industrial	97	1063	1506	2666	3085	1588	4673	6038	327	1457	15161
	Electric Utilities	16	183	393	592	597	1058	1655	2965	95	885	6192
	Transportation	7	50	50	107	250	161	411	465	14	80	1077
	Raw Material & Other	9	116	159	284	266	553	819	1990	122	242	3457
	Total Inc. Field Use	416	2988	2968	6372	7371	4784	12155	12469	907	3991	35894
1985	Residential/Commercial	352	1830	1060	3242	3778	1625	5403	1182	394	1548	11769
	Industrial	124	1276	1940	3340	3802	1804	5605	6872	361	1626	17805
	Electric Utilities	14	185	483	682	672	1121	1793	3852	116	829	7272
	Transportation	8	59	63	130	300	180	480	551	16	87	1264
	Raw Material & Other	9	130	181	320	217	565	782	1774	119	241	3236
	Total Inc. Field Use	507	3480	3727	7714	8769	5295	14064	14231	1006	4331	41346

Reprint from NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 10.

TABLE A3-II

A Market Comparison of Natural Gas Forecasts
Made by the NPC in 1971 and 1973:
Natural Gas Demand - 1970

(10^{12} BTU's)

PAD District I	New England		Middle Atlantic		South Atlantic		Total	
	1971	1973	1971	1973	1971	1973	1971	1973
Residential/Commercial	190	177	1136	1106	551	517	1877	1800
Industrial	63	52	633	578	607	654	1303	1284
Electric Utilities	7	9	212	172	329	324	548	505
Transportation	4	5	32	33	25	27	61	65
Raw Materials	10	8	104	91	133	110	247	209
Total	274	251	2117	1980	1645	1632	4036	3863

PAD District II	East North Central		All Others		Total	
	1971	1973	1971	1973	1971	1973
Residential Commercial	2197	2138	1152	1059	3349	3197
Industrial	1566	1494	960	984	2526	2478
Electric Utilities	194	272	669	669	863	971
Transportation	131	144	102	108	233	252
Raw Materials	307	265	555	445	862	710
Total	4395	4313	3438	3295	7835	7608

	PAD District III		PAD District IV		PAD District V	
	1971	1973	1971	1973	1971	1973
Residential/Commercial	715	734	260	260	1017	910
Industrial	3832	4140	240	238	961	897
Electric Utilities	1732	1617	49	63	857	759
Transportation	271	305	9	10	55	57
Raw Materials	2624	1831	128	104	249	262
Total	9174	8627	686	675	3139	2885

	United States Total	
	1971	1973
Residential/Commercial	7218	6901
Industrial	8862	9037
Electric Utilities	4049	3915
Transportation	629	689
Raw Materials	4110	3116
Total	24868	23658

Sources are listed at end of table.

TABLE A3-II cont.

A Market Comparison of Natural Gas Forecasts
Made by the NPC in 1971 and 1973:
Natural Gas Demand - 1975

(10^{12} BTU's)

PAD District I	New England		Middle Atlantic		South Atlantic		Total	
	1971	1973	1971	1973	1971	1973	1971	1973
Residential/Commercial	239	231	1319	1347	710	682	2268	2260
Industrial	88	77	861	862	934	1132	1883	2071
Electric Utilities	6	17	180	210	335	339	521	566
Transportation	6	6	42	43	36	39	84	88
Raw Materials	10	6	118	106	141	139	269	251
Total	349	337	2520	2568	2156	2331	5025	5236

PAD District II	East North Central		All Others		Total	
	1971	1973	1971	1973	1971	1973
Residential/Commercial	2602	2664	1285	1232	3887	3896
Industrial	2032	2377	1114	1322	3146	3699
Electric Utilities	251	578	774	870	1025	1448
Transportation	179	205	129	137	308	342
Raw Materials	392	346	641	522	1033	868
Total	5456	6170	3943	4083	9399	10253

	PAD District III		PAD District IV		PAD District V	
	1971	1973	1971	1973	1971	1973
Residential/Commercial	800	848	285	310	1186	1125
Industrial	4842	5284	277	298	1227	1289
Electric Utilities	2176	2298	57	83	1050	1068
Transportation	369	393	11	12	75	74
Raw Materials	3117	2079	149	115	223	220
Total	11304	10902	779	818	3761	3776

	United States Total	
	1971	1973
Residential/Commercial	8426	8439
Industrial	11375	12641
Electric Utilities	4829	5463
Transportation	847	909
Raw Materials	4791	3533
Total	30268	30985

Sources are listed at end of table.

TABLE A3-II cont.

A Market Comparison of Natural Gas Forecasts
Made by the NPC in 1971 and 1973:
Natural Gas Demand - 1980

(10^{12} BTU's)

PAD District I	New England		Middle Atlantic		South Atlantic		Total	
	1971	1973	1971	1973	1971	1973	1971	1973
Residential/Commercial	300	287	1544	1576	895	860	2739	2723
Industrial	109	97	996	1063	1224	1506	2329	2666
Electric Utilities	6	16	180	183	335	393	521	592
Transportation	7	7	49	50	45	50	101	107
Raw Materials	12	9	132	116	159	159	303	284
Total	434	416	2901	2988	2658	2968	5993	6372

PAD District II	East North Central		All Others		Total	
	1971	1973	1971	1973	1971	1973
Residential/Commercial	3074	3173	1465	1424	4539	4597
Industrial	2549	3085	1297	1588	3846	4673
Electric Utilities	315	597	901	1058	1216	1655
Transportation	217	250	148	161	365	411
Raw Materials	368	266	635	553	1003	819
Total	6523	7371	4446	4784	10969	12155

	PAD District III		PAD District IV		PAD District V	
	1971	1973	1971	1973	1971	1973
Residential/Commercial	920	1011	323	349	1409	1327
Industrial	5722	6038	330	327	1473	1457
Electric Utilities	2571	2965	68	95	1141	885
Transportation	460	465	13	14	86	80
Raw Materials	2862	1990	151	122	209	242
Total	12535	12469	885	907	4318	3991

	United States Total	
	1971	1973
Residential/Commercial	9930	10007
Industrial	13700	15161
Electric Utilities	5517	6192
Transportation	1025	1077
Raw Materials	4528	3457
Total	34700	35894

Sources are listed at end of table.

TABLE A3-II cont.

A Market Comparison of Natural Gas Forecasts
Made by the NPC in 1971 and 1973:
Natural Gas Demand - 1985

(10^{12} BTU's)

PAD District I	New England		Middle Atlantic		South Atlantic		Total	
	1971	1973	1971	1973	1971	1973	1971	1973
Residential/Commercial	371	352	1788	1830	1113	1060	3272	3242
Industrial	136	124	1139	1276	1609	1940	2884	3340
Electric Utilities	6	14	180	185	335	483	521	682
Transportation	9	8	56	59	55	63	120	130
Raw Materials	13	9	147	130	181	181	341	320
Total	535	507	3310	3480	3293	3727	7138	7714

	East North Central		All Others		Total	
	1971	1973	1971	1973	1971	1973
Residential/Commercial	3668	3778	1656	1625	5324	5403
Industrial	3182	3802	1531	1804	4713	5606
Electric Utilities	393	672	1064	1121	1457	1793
Transportation	265	300	170	180	435	480
Raw Materials	363	217	630	565	993	782
Total	7871	8769	5051	5295	12922	14064

	PAD District III		PAD District IV		PAD District V	
	1971	1973	1971	1973	1971	1973
Residential/Commercial	1060	1182	363	394	1642	1548
Industrial	6765	6872	386	361	1719	1626
Electric Utilities	3046	3852	79	116	1315	829
Transportation	510	551	15	16	100	87
Raw Materials	2714	1774	150	119	201	241
Total	14089	14231	993	1006	4977	4331

	United States Total	
	1971	1973
Residential/Commercial	11661	11769
Industrial	16467	17805
Electric Utilities	6412	7272
Transportation	1180	1264
Raw Materials	4399	3236
Total	40119	41346

Sources: TABLE A-3-II

Future Requirements Committee, Future Gas Requirements of the United States, vol. 3, Future Requirements Agency, Denver Research Institute, University of Denver, Denver, Colorado, October, 1969.

Future Requirements Committee, Future Gas Requirements of the United States, vol. 4, Future Requirements Agency, Denver Research Institute, University of Denver, Denver, Colorado, October, 1971.

TABLE A3-III

Differences Between the NPC's 1971 and 1973 Natural Gas Forecasts in the Residential/Commercial Market - Selected Years

Year	PAD District	Difference between the 1971 Forecast and the 1973 Forecast (10^{12} BTU's)	Percentage Differences 1971 - 1973
1970	I	-77	-4.1%
	II	-152	-4.5
	III	19	2.7
	IV	0	0
	V	-107	-10.5
	Total	-317	-4.4
1975	I	-8	-0.4
	II	9	0.2
	III	48	6.0
	IV	25	8.8
	V	-61	-5.1
	Total	717	2.4
1980	I	-16	-0.6
	II	58	1.3
	III	91	9.9
	IV	26	8.1
	V	-82	-5.8
	Total	77	0.8
1985	I	-30	-0.9
	II	79	1.5
	III	122	11.5
	IV	31	8.5
	V	-94	-5.7
	Total	108	0.9

Sources are listed at end of table.

TABLE A3-III cont.

Differences Between the NPC's 1971 and 1973 Natural Gas Forecasts in the Industrial Market - Selected Years

Year	PAD District	Difference between the 1971 Forecast and the 1973 Forecast (10^{12} BTU's)	Percentage Differences 1971 - 1973
1970	I	-19	-1.5%
	II	-48	-1.9
	III	308	8.0
	IV	-2	-.8
	V	-120	-11.8
	Total	175	2.0
1975	I	188	10.0
	II	553	17.6
	III	442	9.1
	IV	21	7.6
	V	62	5.1
	Total	1266	11.1
1980	I	337	14.5
	II	831	21.6
	III	316	5.5
	IV	-3	-.9
	V	-16	-1.1
	Total	1461	10.7
1985	I	456	15.8
	II	893	18.9
	III	107	1.6
	IV	-25	-6.5
	V	-93	-5.4
	Total	1338	8.1

Sources are listed at end of table.

TABLE A3-III cont.

Differences Between the NPC's 1971 and 1973 Natural Gas Forecasts in the Electric Utilities Market - Selected Years

Year	PAD District	Difference between the 1971 Forecast and the 1973 Forecast (10^{12} BTU's)	Percentage Differences 1971 - 1973
1970	I	-43	-7.8%
	II	108	12.5
	III	-115	-6.6
	IV	14	28.8
	V	-98	-11.4
	Total	-134	-3.3
1975	I	45	8.6
	II	423	41.3
	III	122	5.6
	IV	26	45.6
	V	18	1.7
	Total	634	13.1
1980	I	71	13.6
	II	439	36.1
	III	394	15.3
	IV	27	39.7
	V	-256	-22.4
	Total	675	12.2
1985	I	161	30.9
	II	336	23.1
	III	812	26.7
	IV	37	46.8
	V	-486	-37.0
	Total	860	13.4

Sources are listed at end of table.

TABLE A3-III cont.

Differences Between the NPC's 1971 and 1973 Natural Gas Forecasts in the Transportation Market - Selected Years

Year	PAD District	Difference between the 1971 Forecast and the 1973 Forecast (10^{12} BTU's)	Percentage Differences 1971 - 1973
1970	I	4	6.6%
	II	19	8.2
	III	34	12.5
	IV	1	11.1
	V	2	3.6
	Total	60	9.5
1975	I	4	4.8
	II	34	11.0
	III	24	6.5
	IV	1	9.1
	V	-1	-1.3
	Total	62	7.3
1980	I	6	5.9
	II	46	12.6
	III	5	1.1
	IV	1	7.7
	V	-6	-7.0
	Total	52	5.1
1985	I	10	8.3
	II	45	10.3
	III	41	8.0
	IV	1	6.7
	V	-13	-13.0
	Total	84	7.1

Sources are listed at end of table.

TABLE A3-III cont.

Differences Between the NPC's 1971
and 1973 Natural Gas Forecasts
Raw Material and Others
Selected Years

Year	PAD District	Difference between the 1971 Forecast and the 1973 Forecast (10^{12} BTU's)	Percentage Differences 1971 - 1973
1970	I	-38	-15.4
	II	-152	-17.6
	III	-793	-30.2
	IV	-24	-18.8
	V	13	5.2
	Total	-994	-24.2
1975	I	-18	- 6.7
	II	-165	-16.0
	III	-1038	-33.3
	IV	-34	-22.8
	V	-3	- 1.3
	Total	-1258	-26.3
1980	I	-19	-6.3
	II	-184	-18.3
	III	-872	-30.5
	IV	-29	-19.2
	V	33	15.8
	Total	-1071	-23.7
1985	I	-21	- 6.2
	II	-211	-21.2
	III	-940	-34.6
	IV	-31	-20.7
	V	40	19.9
	Total	-1163	-26.4

Sources are listed at end of table.

TABLE A3-III cont.

Differences Between the NPC's 1971 and 1973 Natural Gas Forecasts in Total of all Markets - Selected Years

Year	PAD District	Difference between the 1971 Forecast and the 1973 Forecast (10^{12} BTU's)	Percentage Differences 1971 - 1973
1970	I	-173	-4.3%
	II	-227	-2.9
	III	-547	-6.0
	IV	- 11	-1.6
	V	-254	-8.1
	Total	-1210	-4.9
1975	I	211	4.2
	II	854	9.1
	III	-402	-3.6
	IV	39	5.0
	V	15	.4
	Total	717	2.4
1980	I	379	6.3
	II	1186	10.8
	III	- 66	- .5
	IV	22	2.5
	V	-327	-7.6
	Total	1194	3.4
1985	I	576	8.1
	II	1142	8.8
	III	142	1.0
	IV	13	1.3
	V	-646	-13.0
	Total	1227	3.1

Sources:

Future Requirements Committee, Future Requirements of the United States, vol. 3, Future Requirements Agency, Denver Research Institute, University of Denver, Denver, Colorado, October, 1969.

Future Requirements Committee, Future Requirements of the United States, vol. 4, Future Requirements Agency, Denver Research Institute, University of Denver, Denver, Colorado, October, 1971.

See Table A-3-II.

Appendix B. National Petroleum Council Assumptions*

NPC Assumptions: General

(1) Though the year 1970 was marked by non-standard economic and political circumstances, the NPC Energy Demand Task Group assumed that the impact of such abnormalities would not significantly affect the long-term growth rates of national energy demand.

(2) GNP, technological and other economic factors were used to project individual market demand estimates. These estimates were then summed to arrive at a national energy demand estimate. No fixed energy demand/GNP ratio was used for projection.

(3) The Nation will continue to rely on private enterprise and free consumer choice.

*Footnotes corresponding to assumption numbers in each subsection start on page B9.

NPC Assumptions: The Residential/Commercial Market

(1) Household projections: Series 2 Bureau of Census (BOC)

	Thousands	Growth Rate from Preceding Period
1970	62,874	1.9%
1975	68,229	1.6
1980	74,728	1.8
1985	81,207	1.7

(2) Population by Age Groups: Series D BOC (million persons)

	A	B	C	D	E
	House Buying Age Groups		Apartment Age Groups		
July 1	0-19	30-54	20-29	Over 55	Total
1970	77.7	57.6	30.2	38.2	203.7
1975	77.3	60.1	36.0	41.4	214.8
1980	77.2	65.1	39.7	44.7	226.7
1985	79.1	72.7	41.4	46.9	240.1

Average Annual Growth Rates

	A	B	C	D	E
1970-1975	-0.1%	0.9%	3.6%	1.6%	1.1%
1975-1980	0	1.6	2.0	1.5	1.1
1980-1985	0.5	2.2	0.8	1.0	1.2

The trend toward smaller dwelling units will continue throughout the 1970's.

(3) The increasing proportion of population in the young adult and senior age groups has caused a clear trend away from single-family homes toward apartments and mobile homes. This trend is expected to continue through the 1970's.

(4) Faster population growth in the suburbs is anticipated. Dependency on the central city for jobs and services will decrease, implying that commuting problems will not significantly impede the trend.

Population Shift to Suburbs

Average Annual Percentage Increase

	1960-1970	1970-1985
Suburbs	2.3	3.2
Central City	0.5	-0.2
Non-Metropolitan	0.5	-0.3

Population in Millions

	1960	1970
Suburbs	59.6	74.9
Central City	59.4	62.2
Non-Metropolitan	60.3	63.2
	179.3	200.3

(5) Electricity consumption in the Residential/Commercial market is projected to increase at a rate of 7.5 percent per year.

Factors stimulating electric utilization:

(a) trend toward construction of apartments and smaller homes

(b) population shift toward warmer climates

(c) larger proportions of "young marrieds" in the housing market

(d) continued rapid growth in air conditioning

(6) An anticipated growth rate of real GNP of more than 4 percent, with the assumption of rising personal incomes and standards of living.

(7) Total energy demand for the residential/commercial sector is relatively insensitive to price changes.

NPC Assumptions: The Industrial Market

(1) Research and development expenditures by industry will continue to expand with normal returns.

(2) Fuel savings will occur as more efficient machinery and production processes are introduced.

(3) Improvement in product quality will require additional energy.

(4) The use of lower-grade ores from deeper mines will cause unit energy requirements to rise.

(5) The trend toward large, well-lighted, air-conditioned factories will continue.

(6) Additional energy will be needed to meet with new environmental standards for manufacturing and mining.

(7) Opportunities to improve industrial efficiency by fuel substitution will be significantly limited.

(8) The supply of gas and low-sulfur heavy fuel oil will be constrained.

(9) Where alternate fuels may be available, the efficiency gains will be below those of the past.

(10)

Average Annual Percentage Change

	Industrial Production	Industrial Electricity Purchased	Industrial Energy Demand	
			Including Electricity Purchased	Excluding Electricity Purchased
1970-1980	4.5	7.0	2.9	2.3
1980-1985	4.2	7.2	2.9	2.0

NPC Assumptions: The Transportation Market

(1) Increases in per capita income will increase car ownership and vacation travel.

(2) Smaller families and the general increase in suburban population will mean people are located closer to shopping centers, recreational facilities, etc. This is expected to reduce consumer interest in multi-car ownership.

(3) Anti-pollution control devices and additional power accessories on vehicles will increase consumption.

(4) Greater utilization and congestion of suburban highways and rural roads will develop.

(5)

Transportation Demand for Electricity
(10^{12} BTU's)

	Total Electricity	Electric Cars	All other uses
1970	31	-	31
1975	43	-	43
1980	67	13	54
1985	117	33	84

(6) There will be some transportation energy demand/cost elasticity.

(7) Possible sources of competition for gasoline are (a) liquefied gas for buses and (b) turbine fuel for heavy duty trucks.

(8) Commercial air transport will increase 8.4 percent annually through 1985.

(9)

Transportation Energy Consumption

	Percentage Growth Rates	Standard/Economy Car Ratio	
		1970	1985
1970-1975	4.1%		
1975-1980	3.7	86/14	65/35
1980-1985	3.4		

NPC Assumptions: The Electric Utility Market

(1) Competition between electricity and fossil fuel occurs primarily in heating where income and price elasticities may be causal factors.

(2) Electricity sales to industry will increase due to the following factors.

a. Expansion of materials handling, electro-metallurgy and automated processing

b. Improved working conditions

c. Environmental protection recycling, air and water treatment.

d. The existence of a substantial volume of self-generating capacity in industry which may be replaced by utility sales.

(3)

	Heat Rate (BTU/KWH)
1970	10,914
1975	10,654
1980	10,405
1985	10,196

(4)

	Average Annual Input Growth Rates (Percent)
1970-1975	7.1
1975-1980	7.0
1980-1985	6.1

(5) Losses as a share of net power generation are expected to remain stable due to the following offsetting conditions:

a. rapid growth of consumption of energy delivered at low voltage

b. increase of underground distribution circuits

c. growing numbers of network interconnections improving long distance power movement

and

i. the use of higher alternate current transmission voltages

ii. direct current transmission over long distance

iii. general advancement of transmission and distribution technology

(6) All utility primary fuel demand not supplied by oil, gas, hydro or geothermal will be met by coal and/or nuclear.

General Comparison of Alternate Forecasting Assumptions

		NPC	FPC	BOM[1]	NERA
GNP-Annual growth rate (Percent)	1970-1980	4.2 [2]	4.0 [3]	4.3	3.75
	1980-1985	4.2	4.0	4.0	3.75
Population-Annual growth rate (Percent)	1970-1975	1.0[4]	1.3[5]	1.0[6]	
	1975-1980	1.1			
	1980-1985	1.2			
Population (millions)	1975	215.6[7]		216.2	
	1980	227.5		229.4	
	1985	240.9		243.3	
Industrial Production-Annual growth rate	1970-1980	4.5			5
	1980-1985	4.5			4.4
Fuel availability		Adequate on world basis	Some restriction	Restrictions of supply (especially natural gas)	
Price		Competitive	NA	Competitive rates of increase: gaseous fuels = 1.5 x petroleum 2.0 x coal	
Technology[8]		No major changes in Government policies, evolutionary	Evolutionary	Based on specific contingencies evolutionary and revolutionary	

FOOTNOTES to APPENDIX B

NPC Assumptions: General

(1) NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 2.

(2) Ibid., p. 3.

(3) National Petroleum Council, U.S. Energy Outlook, Dec. 1972, p. 16.

NPC Assumptions: The Residential/Commercial Market

(1) NPC, "An Initial Appraisal by the Energy Demand Task Group, 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 12.

(2) Ibid., p. 13.
National Petroleum Council, U.S. Energy Outlook, Dec. 1972, p. 42.

(3) NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 14.

(4) Ibid., p. 15.

(5) Idem.

(6) Idem.

(7) Idem.

(8) National Petroleum Council, U.S. Energy Outlook, Dec. 1972, p. 44.

NPC Assumptions: The Industrial Market

(1-9) NPC, "An Initial Appraisal by the Energy Demand Task Group, 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 19.

(10) Ibid., p. 20.

NPC Assumptions: The Transportation Market

(1) NPC, "An Initial Appraisal by the Energy Demand Task Group, 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 21.

(2) Ibid., p. 22.

(3) Idem.

(4) Ibid., p. 23.

(5) Idem.

(6) National Petroleum Council, U.S. Energy Outlook, Dec. 1972, p. 48.

(7) NPC, "An Initial Appraisal by the Energy Demand Task Group, 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 24.

(8) Ibid., p. 25.

(9) Idem.

NPC Assumptions: The Electric Utility Market

(1) NPC, "An Initial Appraisal by the Energy Demand Task Group, 1971-1985", U.S. Energy Outlook: An Interim Report, 1972, p. 26.

(2) Ibid., p. 26.

(3) Ibid., p. 28.

(4) Idem.

(5) Ibid., p. 29.

(6) National Petroleum Council, U.S. Energy Outlook, Dec. 1972, p. 23.

General Comparison of Alternate Forecasting Assumptions

(1) Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, pp. 17, 18.

(2) National Petroleum Council, U.S. Energy Outlook, Dec. 1972, p. 40.

(3) Federal Power Commission, "Guidelines for the Growth of the Electric Power Industry," The 1970 National Power Survey, Part I, U.S. Government Printing Office, Washington, Dec. 1971, p. 40.

(4) NPC, "An Initial Appraisal by the Energy Demand Task Group, 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 6 (See also pp. 41, 42) Series D.

(5) Federal Power Commission, Op. Cit. p. 3-13.

(6) Idem., midpoint of series D & E.

(7) NPC, "An Initial Appraisal by the Energy Demand Task Group, 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 6.

(8) Committee on Interior and Insular Affairs, United States Senate, Survey of Energy Consumption Projections, U.S. Government Printing Office, Washington: 1972, pp. 14, 15.

APPENDIX C: COMPARATIVE PROJECTIONS

FUEL USE BY CONSUMING SECTORS

Appendix C consists of two parts: first, a comparison among national forecasts, by fuel, within each market sector; second, a listing of data sources for the electric utility market used by each forecasting committee in determining the individual fuel demand.

Table C-I compares national forecasts of fuel demand made by this study, the NPC, the BOM, and the FRC. Tables C-II through C-V divide these national demands into market sectors. The NPC and BOM demand estimates are compared by fuel in the residential/commercial, industrial and transportation markets. Table V is an electric utility market comparison involving the NPC, BOM, FPC, and the EEI. Tables C-VA through C-VD follow with a listing of sources for each fuel demand forecast by each organization used in the comparison.

All fuel demands are compared in terms of fuel units, but total market demand is compared on a BTU basis. As seen in the case of the NPC, the total market demand does not necessarily represent a summation of the individual fuel demands. The NPC market demands were dictated by a co-ordinating committee through trend extrapolations, while the individual fuel demands were made by independent fuel task groups. The NPC fuel demands by market were therefore made on the basis of past fuel demand within the market and not in correspondence to a fixed market demand.

TABLE C-I

A Comparison of Fossil Fuel Demand Projections
Current Forecast
BOM, NPC and FRC for Selected Years

(10^{12} BTU's)

Petroleum

	Current Forecast	BOM	NPC
1970	29,335	29,614	29,665
1975	37,261	35,090	36,967
1980	48,766	42,190	44,993
1985	61,137	50,700	52,344

Coal

	Current Forecast	BOM	NPC
1970		12,922	13,062
1975		13,825	15,554
1980		16,140	18,284
1985		21,470	21,388

Coal - Excluding Coking Coal

	Current Forecast	BOM	NPC
1970	9,897		10,374
1975	11,041		12,418
1980	11,316		14,924
1985	11,996		17,860

Natural Gas - Excluding Nonenergy Use

	Current Forecast	BOM	NPC (A)	NPC (B)	FRC
1970	20,667	21,342	20,758	20,542	20,542
1975	27,623	24,520	25,477	27,452	27,452
1980	32,635	26,230	30,172	32,437	32,437
1985	38,354	27,590	35,720	38,110	38,110

Sources: TABLE C-I

Reference Tables for the Current Forecasts: Table I.

Sources for the BOM fuel demand projections:

Petroleum: Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, Appendix B, Table I and p. 21.

Coal: Ibid., Appendix B, Table 25, and p. 23.

Natural gas: Ibid, Appendix B, Table 22 and pp. 21, 40.

Sources for the NPC fuel demand projections:

Petroleum: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 16.

Coal: Ibid. p. 127

Natural gas: NPC (A) forecast: Ibid., p. 102.

NPC (B) forecast: NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 10.

Source for the FRC natural gas forecast:

Future Requirements Committee, Future Gas Requirements of the United States, vol. 4, Future Requirements Agency, Denver Research Institute, University of Denver, Denver, Colorado, October 1971, p. 24.

TABLE C-II

A National Comparison of Fossil Fuel Demand Projections in the Residential/Commercial Market - NPC and the BOM

	1975		1980		1985	
	NPC	BOM	NPC	BOM	NPC	BOM
Petroleum (10^6 B/Yr)	1058	1040	1133	1163	1204	1347
Coal (10^6 T/Yr)	7	12	5	11	3	4
Natural gas (10^9 CF/Yr) A.	8173	8400	9631	9195	11310	9758
B.	8439		10007		11767	
Total (10^{12} BTU's)	14733	14735	16669	16220	18678	17640

Sources for the NPC fuel demand projections:

Petroleum: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 59.

Coal: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 127.

Natural gas:
Forecast A: Ibid, p. 102
Forecast B: NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 10.

Total: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 7. This is a revised estimate and does not represent the sum of the individual fuel demands.

Source for the BOM fuel demand projections:

Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, p. 34. The total estimate excludes nonfuel petroleum use.

TABLE C-III

A National Comparison of Fossil Fuel Demand Projections in the Industrial Market - NPC and BOM

	1975		1980		1985	
	NPC	BOM	NPC	BOM	NPC	BOM
Petroleum (10^6 B/Yr)	1435.3	1186	1797.3	1383	2200	1663
fuel	671.2	666	823.4	750	979.3	953
nonfuel (10^6 B/Yr)	764	540	973.9	633	1221.4	710
Coal (10^6 T/Yr)	199	169	204	175	206	190
Natural gas (10^9 CF/Yr) A.	11033	11387	13288	12124	15972	12842
B.	12641		15161		17805	
Total (10^{12} BTU's)	20039	22850	22341	24840	24667	27520

Sources:

Sources for the NPC fuel demand projections:

Petroleum: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 67-70.

Coal: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 128.

Natural gas: Forecast A: Ibid, p. 102.

Forecast B: NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 10.

Total: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 7 (revised figure).

Source for the BOM fuel demand projection:

Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, p. 40.

TABLE C-IV

A National Comparison of Fossil Fuel Demand Projections in the Transportation Market - NPC and BOM

		1975		1980		1985	
		NPC	BOM	NPC	BOM	NPC	BOM
Petroleum (10^6 B/Yr)		3521.2	3360	4298.5	3992	5037.4	4739
Natural Gas (10^9 CF/Yr)	A.	822	989	994	1352	1145	1591
	B.	909		1077		1264	
Total (10^{12} BTU)		19905	19070	23870	22840	28214	27090

Sources:

Sources for the NPC fuel demand projections:

Petroleum: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 88.

Natural gas: Forecast A: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 102.

Forecast B: NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 10.

Total: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 7 (revised estimates).

Source for the BOM fuel demand projections:

Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, p. 38.

TABLE C-V

A National Comparison of Fuel Demand Projections in the Electric Utility Market - NPC, FPC, BOM, and EEI Projections

	NPC (A)	NPC (B)	FPC	BOM	EEI
			Petroleum (mil B/Yr)		
1975	619		565	573	
1980	855		640	800	375.4
1985	972		725	1064	329.7
			Coal (mil T/Yr)		
1975	415		425	384	
1980	525		500	460	441.8
1985	654		600	613	470.8
			Natural Gas (BCF/Yr)		
1975	4684	5463	4110	3686	
1980	5351	6192	3800	3492	6072.9
1985	6219	7272	3800	3346	6497.8
			Nuclear (BKWHr/Yr)		
1975	326			240	
1980	926		775	630	945
1985	2067			1130	1925
			Nuclear (MW(e)/Yr)		
1975	59000			50000	
1980	150000		147000	120000	135000
1985	300000		215000	275000	
	Assumed Nuclear Load Factors for the First Year of Operation				
1975	.50		-	.55	.80
1980	.60			.60	.80
1985	.80			.60	.80
			Total Market Energy Demand (BKWHr/Yr)		
1975				2130	
1980	3075			3000	3082
1985				4140	4256

Sources: TABLE C-V

Source for the NPC fuel demand projections:

Petroleum: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 111.

Coal: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 128.

Natural gas: Forecast A: Ibid., p. 102.

Forecast B: NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 10.

Nuclear: NPC, "An Initial Appraisal by the Energy Demand Task Group, 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. xxiv.

NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 147, 148.

Source for the FPC fuel demand projections:

Fossil fuels: Federal Power Commission, "Guidelines for the Growth of the Electric Power Industry," The 1970 National Power Survey, Part I, U.S. Govt. Printing Office, Washington, Dec. 1971, p. 4-2.

Nuclear: Ibid., p. 1-17.

Total: Ibid., p. 3-13.

Source for the BOM fuel demand projections:

Fossil fuels: Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, p. 28.

Nuclear and total: Ibid., p. 26.

Source for the EEI fuel demand projections:

Fossil fuels: National Economic Research Associates, Inc., Fuels for the Electric Utility Industry 1971-1985, A Report to the Edison Electric Institute, Aug. 1972, p. 29.

Sources: TABLE C-V cont.

Nuclear
and total: Ibid., p. 28.

TABLE C-V A

NPC Sources Used for Forecasting Demand in the Electric Utility Market

Fuel	Organization Referred To	Reference
Petroleum	FPC	NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 101-110.
Residual fuel oil	BOM (from FPC)	Ibid., p. 111.
Distillate fuel oil	BOM (from FPC)	Ibid., p. 112.
Coal	Coal task group Chairman - Consolidation Coal Co.	NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 128.
	Backed up by FPC & NERA	Ibid., p. 129
Natural Gas	Future Requirements Committee	Ibid., p. 102, pp. 99-103.
Hydro	New Energy Forms Task Group Chairman - Gulf Oil	Ibid., pp. 184-185.
Geothermal	New Energy Forms Task Group Chairman - Gulf Oil	NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. xxiii.
Nuclear	AEC	NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 149.

TABLE C-V B

FPC Sources Used for Forecasting Demand in the Electric Utility Market

Fuel	Organization Referred To	Reference
All, except natural gas	FPC	Federal Power Commission, "Guidelines for the Growth of the Electric Power Industry," The 1970 National Power Survey, Part I, U.S. Govt. Printing Office, Washington, Dec. 1971, p. 3-12.
Natural gas	FRC	Ibid., p. 3-12.

TABLE C-V C

BOM Sources Used for Forecasting Demand in the Electric Utility Market

All fossil fuels	FPC	Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, p. 28.

TABLE C-V D

EII Sources Used for Forecasting Demand in the Electric Utility Market

All fuels	FPC FPC, Bulk Power Supply Information, April 1, 1973.	National Economic Research Associates, Inc. Fuels for the Electric Utility Industry 1971-1985, A Report to the Edison Electric Institute, Aug. 1972, p. 28-29.

APPENDICES D AND E: FORECAST COMPARISONS

Appendices D and E are a set of comparisons among forecasts made by four organizations. The first is on a fuel unit basis, the second on a common BTU basis. Two of the organizations, the National Petroleum Council (NPC) and the Department of the Interior, published separate national energy projections in December 1972. They are consistently compared within the report.(1) The initiator of these forecasting efforts was the Department of the Interior which, in 1970, asked the NPC (an officially established industry advisory board to the Secretary of the Interior) to make a national energy forecast. The NPC responded with the publication of an Interim Report in 1971. In the same year Walter G. Dupree, Jr. and James A. West, Bureau of Mines, Department of the Interior published their initial forecast.(2) Detailed electric utility projections were published by the Federal Power Commission (FPC)(3) and the Edison Electric Institute (EEI).(4)

Four market sectors were examined with respect to comparisons among the forecasts within each sector. The NPC made its estimates on a regional basis by Petroleum Administration for Defense (PAD) district. The districts are delineated below.

PAD District I:	The New England, Middle Atlantic and South Atlantic regions.
PAD District II:	The West North Central and East North Central regions, plus the states of Oklahoma, Kentucky and Tennessee.
PAD District III:	The states of New Mexico, Texas, Arkansas, Louisiana, Mississippi and Alabama.
PAD District IV:	The states of Montana, Idaho, Wyoming, Utah and Colorado.
PAD District V:	The Pacific region and the states of Nevada and Arizona.

The BOM and EEI forecasts were made only on a national basis. The FPC made a regional forecast. For purposes of this study, the PAD district breakdown was considered more useful than other

possible regional breakdowns in dealing with petroleum demand and supply, as this led to consistency in interfuel comparisons on the demand side.

Tables D-I through D-III compare NPC and BOM energy demand projections by fuel for the residential/commercial, industrial and transportation markets. The projections at five-year intervals through 1985. The NPC forecast includes fuel and fuel product demand by PAD District, while the BOM projects only total fuel demand on a national scale. Therefore, direct comparison can only be made on the national level and only for total petroleum (fuel and non-fuel), coal and natural gas demand.

Table D-IV is a comparison among estimates of petroleum, coal, natural gas, hydropower, geothermal and nuclear demand in the electric utility market by the NPC, the FPC, the BOM and the EEI. This comparison also runs through 1985. The direct correspondence is on the national level.

Tables E-I through E-IV compare energy demand in a similar manner to the comparisons in Tables D-I through D-IV. The difference is that in Appendix E the comparisons are made in terms of Btu's, while in Appendix D the comparisons were made in fuel units. Appendix E also contains a total fossil fuel demand comparison. This is a summation of petroleum, coal and natural gas demand. In the NPC total fossil fuel demand, only case A of the two natural gas demands presented were summed.

In Table E-II the total NPC intermediate projection is a revised estimate made in conjunction with their intermediate national forecast. In Table E-III the 5,800 MBtu's of crude oil equivalent was calculated by using a 5,800 MBtu/Bbl ration applied to the total petroleum demand estimates shown in Table D-III. The NPC energy tables revised petroleum demands are the revised estimates used in the NPC's composite study.

FOOTNOTES TO APPENDICES D and E

(1) National Petroleum Council, U.S. Energy Outlook, Dec. 1972. Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972.

(2) NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, Volume one, July 1971; BOM, Mineral Facts and Problems--1970 Edition: BOM Bulletin 650, U.S. Department of the Interior, 1971. Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972.

(3) Federal Power Commission, "Guidelines for the Growth of the Electric Power Industry," The 1970 National Power Survey, Part I, U.S. Government Printing Office, Washington, Dec. 1971.

(4) National Economic Research Associates, Inc., Fuels for the Electric Utility Industry 1971-1985, A Report to the Edison Electric Institute, Aug. 1972.

TABLE D-I

Residential/Commercial Energy Demand Projections-Comparisons 1970
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior-BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum-Fuel & Nonfuel (mil B/Yr)							1149.6
Petroleum-Fuel (MB/D)	1508	764	154	56	125	2607	
Petroleum-Fuel (mil B/Yr)	550	279	56	20	46	951.6	982.4
Petroleum-Nonfuel (mil B/Yr)							167.2
LPG (MB/D)	90	243	120	22	29	504	
Kerosine (MB/D)	110	66	20	4	2	202	
Distillate (MB/D)	915	390	12	23	65	1405	
Residual (MB/D)	393	65	2	7	29	496	
Coal (mil T/Yr)						10	16.114
{Electricity purchased} (BKWH)							879
A. Natural gas (BCF/Yr)	1820	3250	690	250	990	7000	6894.007
B. Natural gas (BCF/Yr)	1800	3197	734	260	910	6901	

Sources are listed at the end of the table.

TABLE D-I cont.

Residential/Commercial Energy Demand Projections-Comparisons 1975
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior-BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum-Fuel & Nonfuel (mil B/Yr)							1221
Petroleum-Fuel (MB/D)	1656	867	177	66	132	2898	
Petroleum-Fuel (mil B/Yr)	604	316	65	24	48	1057.8	1040
Petroleum-Nonfuel (mil B/Yr)							181
LPG (MB/D)	115	311	140	27	32	625	
Kerosine (MB/D)	101	61	18	8	2	185	
Distillate (MB/D)	998	415	16	28	68	1525	
Residual (MB/D)	442	80	3	8	30	563	
Coal (mil T/Yr)						7	
{Electricity purchased} (BKWH)							1242
A. Natural gas (BCF/Yr)	2200	3770	776	276	1150	8173	8400
B. Natural gas (BCF/Yr)	2260	3896	848	310	1125	8439	

Sources are listed at the end of the table.

TABLE D-I cont.

Residential/Commercial Energy Demand Projections-Comparisons 1980
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior-BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum-Fuel & Nonfuel (mil B/Yr)							1356
Petroleum-Fuel (MB/D)	1769	921	205	76	133	3104	
Petroleum-Fuel (mil B/Yr)	646	336	75	28	49	1133	1163
Petroleum-Nonfuel (mil B/Yr)							193
LPG (MB/D)	130	339	165	32	34	700	
Kerosine (MB/D)	93	57	16	2	2	170	
Distillate (MB/D)	1083	435	20	33	69	1640	
Residual (MB/D)	463	90	4	9	28	594	
Coal (mil T/Yr)						5	
{Electricity purchased} (BKWH)							
A. Natural gas (BCF/Yr)	2657	4403	892	313	1367	9631	1770
B. Natural gas (BCF/Yr)	2723	4597	1011	349	1327	10,007	9195

Sources are listed at the end of the table.

TABLE D-I cont.

Residential/Commercial Energy Demand Projections-Comparisons 1985
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior-BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum-Fuel & Nonfuel (mil B/Yr)							1546
Petroleum-Fuel (MB/D)	1875	975	229	86	134	3299	
Petroleum-Fuel (mil B/Yr)	684	356	84	31	49	1204.1	1347
Petroleum-Nonfuel (mil B/Yr)							199
LPG (MB/D)	145	372	185	37	36	775	
Kerosine (MB/D)	85	53	14	1	2	155	
Distillate (MB/D)	1167	450	25	38	70	1750	
Residual (MB/D)	478	100	5	10	26	619	
Coal (mil T/Yr)						3	
{Electricity purchased} (BKWH)							2286
A. Natural gas (BCF/Yr)	3174	5164	1028	352	1583	11,310	9758
B. Natural gas (BCF/Yr)	3242	5403	1182	394	1548	11,769	

Sources are listed at the end of the table.

Sources: TABLE D-I

NPC fuel demand statistics:

Petroleum fuel oils:	NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 60-64, 102.
Coal:	NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 128.
Natural gas:	
A. first estimate	Ibid., p. 102.
B. second estimate	NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 10.

The first estimate utilizes a conversion factor of 1031 BTU/CF. The second estimate uses a conversion factor of 1000 BTU/CF.

BOM fuel demand statistics:

1970:	Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, Appendix B, Table 13.
1975-1985:	Ibid., p. 34.

TABLE D-II

Industrial Energy Demand Projections - Comparisons 1970
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior - BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum Total (mil B/Yr)						1129.4	961.4
Petroleum Fuel (mil B/Yr)	177	155	116	21	79	547.5	546.5
Petroleum (MB/D) Excluding Raw Material	484	424	319	57	216	1500	
Distillate (MB/D)	30.1	38.5	15.8	5.4	17.2	107.0	
Residual (MB/D)	103.5	32.5	4.5	6.5	23.5	170.5	
LPG (mil gal./Yr)	353	500	172	43	129	1197	
Petroleum Coke (mil B/Yr)	9.0	15.0	23.0	2.0	5.4	54.4	
Still Gas (mil B/Yr)	21.2	49.3	60.5	4.5	29.5	165.0	
Kerosine & Other (mil B/Yr)	4.5	7.4	8.7	1.4	0.1	22.1	
Petroleum Raw Materials Nonfuel Uses (mil B/Yr)						589.9	414.9
(MB/D)						1594.2	
Lubricants (mil B/Yr)	19.4	15.1	7.8	2.2	4.8	49.3	
(MB/D)						135.1	
Asphalt & Road Oil (mil B/Yr)	43.4	58.7	26.0	10.5	22.3	160.6	
(MB/D)						440.0	
Wax, Coke, & Miscellaneous (mil B/Yr)	8.5	14.2	13.3	1.3	4.8	42.1	
(MB/D)						115.3	
Special Naphtha (mil B/Yr)	8.6	7.5	10.2	0.4	4.6	31.3	
(MB/D)						85.8	
Petro Chemical Feedstock LPG - Chemical Use (mil gal/Yr)	635	690	6802	-	290	8417	
(M gal/D)						549.0	
Still Gas, Naptha, & Miscellaneous Feedstock (mil B/Yr)	10.5	12.0	69.8	0.5	5.4	98.2	
(MB/D)						269.0	
Coal-total (mil T/Yr)						187	186.637
Coal-industrial (mil T/Yr)						91	
Coking Coal (mil T/Yr)						96	
Fuel Coal (mil T/Yr)							181.027
Nonfuel Coal (mil T/Yr)							5.610
A. Natural Gas (BCF/Yr)	1264	2450	3717	233	932	8596	9856.844
Fuel (BCF/Yr)							9190.960
Nonfuel (BCF/Yr)							665.884
B. Natural Gas (BCF/Yr)	1284	2478	4140	238	897	9037	
Electricity Purchased (BKWH)							648

Sources are listed at end of table.

TABLE D-II cont.

Industrial Energy Demand Projections - Comparisons 1975
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior - BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum Total (mil B/Yr)						1435.3	1186
Petroleum Fuel (mil B/Yr)	218	191	131	28	103	671.2	666
Petroleum (MB/D) Excluding Raw Material	598	522	361	76	282	1839	
Distillate (MB/D)	33.1	44.5	18.5	7.1	21.3	124.5	
Residual (MB/D)	128.0	45.6	6.4	9.5	30.1	219.6	
LPG (mil gal./Yr)	508	715	248	61	185	1717	
Petroleum Coke (mil B/Yr)	11.5	17.1	26.8	2.4	7.6	65.4	
Still Gas (mil B/Yr)	29.5	47.8	64.2	5.5	39.4	196.4	
Kerosine & Other (mil B/Yr)	4.0	8.2	10.0	2.0	0.1	24.3	
Petroleum Raw Materials Nonfuel Uses (mil B/Yr)						764	520
(MB/D)						2093.3	
Lubricants (mil B/Yr)	21.4	16.6	8.6	2.5	5.3	54.4	
(MB/D)						149.0	
Asphalt & Road Oil (mil B/Yr)	50.0	77.1	34.6	13.3	30.0	204.5	
(MB/D)						560.3	
Wax, Coke, & Miscellaneous (mil B/Yr)	9.5	15.8	14.8	1.3	6.0	47.4	
(MB/D)						129.9	
Special Naphtha (mil B/Yr)	9.2	8.0	10.9	0.4	5.0	33.5	
(MB/D)						91.8	
Petro Chemical Feedstock LPG - Chemical Use (mil gal/Yr)	1025	1071	9388	-	400	11,884	
(M gal/D)						775.2	
Still Gas, Naptha, & Miscellaneous Feedstock (mil B/Yr)	14.8	15.8	102.2	0.5	8.0	141.3	
(MB/D)						387.1	
Coal-total (mil T/Yr)						199	169
Coal-industrial (mil T/Yr)						87	
Coking Coal (mil T/Yr)						112	
Fuel Coal (mil T/Yr)							163
Nonfuel Coal (mil T/Yr)							6
A. Natural Gas (BCF/Yr)	1826	3051	4696	269	1190	11,033	11,387
Fuel (BCF/Yr)							10,710
Nonfuel (BCF/Yr)							677
B. Natural Gas (BCF/Yr)	2071	3699	5284	298	1289	12,641	-
Electricity Purchased (BKWH)							882

Sources are listed at end of table.

TABLE D-II cont.

Industrial Energy Demand Projections - Comparisons 1980
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior - BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum Total (mil B/Yr)						1797.3	1383
Petroleum Fuel (mil B/Yr)	273	237	155	36	122	823.4	750
Petroleum (MB/D) Excluding Raw Material	749	649	426	99	333	2256	
Distillate (MB/D)	36.9	50.1	21.6	8.8	24.2	141.6	
Residual (MB/D)	150.5	60.0	17.5	13.0	33.8	274.8	
LPG (mil gal./Yr)	772	1094	377	95	280	2618	
Petroleum Coke (mil B/Yr)	17.5	20.1	28.0	2.9	10.4	78.9	
Still Gas (mil B/Yr)	46.0	70.7	67.3	6.7	46.0	236.7	
Kerosine & Other (mil B/Yr)	4.5	10.0	12.0	2.5	0.1	29.1	
Petroleum Raw Materials Nonfuel Uses (mil B/Yr)						973.9	633
(MB/D)						2668.1	
Lubricants (mil B/Yr)	23.7	18.4	9.5	2.9	5.7	60.2	
(MB/D)						164.9	
Asphalt & Road Oil (mil B/Yr)	60.2	92.1	39.8	16.0	37.5	245.6	
(MB/D)						672.9	
Wax, Coke, & Miscellaneous (mil B/Yr)	10.4	17.4	16.3	1.4	6.7	52.2	
(MB/D)						143.0	
Special Naphtha (mil B/Yr)	10.0	8.9	12.1	0.5	5.5	37.0	
(MB/D)						101.4	
Petro Chemical Feedstock LPG - Chemical Use (mil gal/Yr)	1500	1635	12335	-	550	16020	
(M gal/D)						1045.1	
Still Gas, Naptha, & Miscellaneous Feedstock (mil B/Yr)	35.0	20.5	130.8	0.6	10.5	197.4	
(MB/D)						540.8	
Coal-total (mil T/Yr)						204	175
Coal-industrial (mil T/Yr)						84	
Coking Coal (mil T/Yr)						120	
Fuel Coal (mil T/Yr)							168
Nonfuel Coal (mil T/Yr)							7
A. Natural Gas (BCF/Yr)	2259	3730	5550	320	1429	13288	12124
Fuel (BCF/Yr)							11394
Nonfuel (BCF/Yr)							730
B. Natural Gas (BCF/Yr)	2666	4673	6038	327	1457	15161	-
Electricity Purchased (BKWH)							1221
Synthetic Gas (BCF/Yr)							380

Sources are listed at end of table.

TABLE D-II cont.

Industrial Energy Demand Projections - Comparisons 1985
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior - BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum Total (mil B/Yr)						2200	1663
Petroleum Fuel (mil B/Yr)	337	227	179	45	142	979.3	953
Petroleum (MB/D) Excluding Raw Material	923	758	490	123	389	2683	
Distillate (MB/D)	41.0	57.5	25.0	10.5	29.1	163.1	
Residual (MB/D)	165.5	70.0	82.5	16.0	36.7	310.7	
LPG (mil gal./Yr)	1081	1530	530	132	392	3665	
Petroleum Coke (mil B/Yr)	27.5	22.7	29.0	3.5	12.7	95.4	
Still Gas (mil B/Yr)	72.5	77.8	75.0	8.0	54.2	287.5	
Kerosine & Other (mil B/Yr)	5.0	12.0	15.0	3.2	0.1	35.3	
Petroleum Raw Materials Nonfuel Uses (mil B/Yr)						1221.4	710
(MB/D)						3346.4	
Lubricants (mil B/Yr)	26.2	20.4	10.6	3.4	6.1	66.7	
(MB/D)						182.7	
Asphalt & Road Oil (mil B/Yr)	72.0	108.7	47.6	19.1	46.5	293.9	
(MB/D)						805.2	
Wax, Coke, & Miscellaneous (mil B/Yr)	11.6	19.2	18.0	1.5	7.5	57.8	
(MB/D)						158.4	
Special Naphtha (mil B/Yr)	11.2	9.7	13.2	0.5	6.0	40.6	
(MB/D)						111.2	
Petro Chemical Feedstock LPG - Chemical Use (mil gal/Yr)	2200	2259	15628	-	750	20837	
(M gal/D)						1359.3	
Still Gas, Naptha, & Miscellaneous Feedstock (mil B/Yr)	53.2	22.6	172.7	0.8	13.0	266.3	
(MB/D)						729.6	
Coal-total (mil T/Yr)						206	190
Coal-industrial (mil T/Yr)						80	
Coking Coal (mil T/Yr)						126	
Fuel Coal (mil T/Yr)							178
Nonfuel Coal (mil T/Yr)							12
A. Natural Gas (BCF/Yr)	2797	4571	6562	374	1667	15972	12842
Fuel (BCF/Yr)							12062
Nonfuel (BCF/Yr)							780
B. Natural Gas (BCF/Yr)	3340	5606	6872	361	1626	17805	-
Electricity Purchased (BKWH)							1843
Synthetic Gas (BCF)							1060

Sources are listed at end of table.

Sources for Table D-II

Sources for the NPC fuel demand statistics

Petroleum fuels:

NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 52, 67-70.

Coal:

NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 128.

Natural gas

A. First estimate:

NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 102.

B. Second estimate:

NPC, U.S. Energy Outlook: Gas Demand, 1973, p. 10.

Sources for the BOM fuel demand statistics

1970:

Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, Appendix B, Table 10.

1975-1985:

Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, p. 40.

TABLE D-III

Transportation Energy Demand Projections - Comparisons 1970
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior--BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum (mil B/Yr)	976.4	908.9	391	86.5	498	2860.9	2902.8
Petroleum (MB/D)	2675	2490	1071	237	1365	7838	
Motor Gasoline (MB/D)	2003	2025	733	171	853	5785	
Aviation Gasoline (MB/D)	13	12	15	2	13	55	
Naphtha Jet (MB/D)	67	42	35	7	94	245	
Kerosine Jet (MB/D)	280	152	55	20	213	720	
Distillate-Vessels (MB/D)	16	10	16	--	11	53	
Distillate-Railroad (MB/D)	58	81	33	20	42	234	
Distillate-Highway (MB/D)	122	138	57	14	59	390	
Kerosine-Highway (MB/D)	--	--	--	--	--		
LPG & LNG Internal Combustion (MB/D)	8	26	66	3	3	106	
Residual Bunker (MB/D)	108	4	61	--	77	250	
Coal (mil T/Yr)							.298
A. Natural Gas (BCF/Yr)	59	226	263	9	53	610	722.166
B. Natural Gas (BCF/Yr)	65	252	305	10	57	689	
Electricity Purchased (BKWH)							5

Sources are listed at the end of the table.

TABLE D-III cont.

Transportation Energy Demand Projections - Comparisons 1975
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior--BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum (mil B/Yr)	1205	1103	477	107	629	3521.2	3360
Petroleum (MB/D)	3301	3023	1307	294	1722	9647	
Motor Gasoline (MB/D)	2400	2405	900	205	1040	6950	
Aviation Gasoline (MB/D)	11	10	12	2	13	48	
Naphtha Jet (MB/D)	60	38	32	7	83	220	
Kerosine Jet (MB/D)	451	243	91	33	350	1168	
Distillate-Vessels (MB/D)	17	11	17	--	12	57	
Distillate-Railroad (MB/D)	66	88	39	24	54	271	
Distillate-Highway (MB/D)	159	182	75	18	78	512	
Kerosine-Highway (MB/D)	3	3	2	--	2	10	
LPG & LNG Internal Combustion (MB/D)	15	38	74	5	8	140	
Residual Bunker (MB/D)	119	5	65	--	82	271	
Coal (mil T/Yr)							
A. Natural Gas (BCF/Yr)	81	299	358	11	73	822	989
B. Natural Gas (BCF/Yr)	88	342	393	12	74	909	
Electricity Purchased (BKWH)							6

Sources are listed at the end of the table.

TABLE D-III cont.

Transportation Energy Demand Projections - Comparisons 1980
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior--BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum (mil B/Yr)	1469	1338	578	130	783	4298.5	3992
Petroleum (MB/D)	4026	3665	1583	356	2144	11774	
Motor Gasoline (MB/D)	2820	2835	1080	235	1230	8200	
Aviation Gasoline (MB/D)	14	14	15	3	17	63	
Naphtha Jet (MB/D)	58	36	30	6	80	210	
Kerosine Jet (MB/D)	672	361	139	49	256	1747	
Distillate-Vessels (MB/D)	18	11	18	--	13	60	
Distillate-Railroad (MB/D)	75	96	46	31	66	314	
Distillate-Highway (MB/D)	204	234	100	23	103	664	
Kerosine-Highway (MB/D)	11	13	5	1	5	35	
LPG & LNG Internal Combustion (MB/D)	25	60	80	8	17	190	
Residual Bunker (MB/D)	129	5	70	--	87	291	
Coal (mil T/Yr)							
A. Natural Gas (BCF/Yr)	98	354	446	13	83	994	1358
B. Natural Gas (BCF/Yr)	107	411	465	14	80	1077	
Electricity Purchased (BKWH)							9

Sources are listed at the end of the table.

TABLE D-III cont.

Transportation Energy Demand Projections - Comparisons 1985
(Fuel Units)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior--BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum (mil B/Yr)	1716	1551	677	156	938	5037.4	4739
Petroleum (MB/D)	4700	4250	1854	428	2569	13801	
Motor Gasoline (MB/D)	3140	3180	1240	270	1370	9200	
Aviation Gasoline (MB/D)	19	18	20	5	22	84	
Naphtha Jet (MB/D)	59	34	28	5	77	200	
Kerosine Jet (MB/D)	922	493	194	69	726	2404	
Distillate-Vessels (MB/D)	20	12	19	--	14	65	
Distillate-Railroad (MB/D)	85	109	54	38	78	364	
Distillate-Highway (MB/D)	230	269	116	25	117	757	
Kerosine-Highway (MB/D)	43	45	20	4	23	135	
LPG & LNG Internal Combustion (MB/D)	45	85	88	12	50	280	
Residual Bunker (MB/D)	140	5	75	--	92	312	
Coal (mil T/Yr)							
A. Natural Gas (BCF/Yr)	116	422	495	15	97	1145	1591
B. Natural Gas (BCF/Yr)	130	480	551	16	87	1264	
Electricity Purchased (BKWH)							11

Sources are listed at the end of the table.

Sources: TABLE D-III cont.

Sources for the NPC fuel demand statistics:

Petroleum fuels: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 88-94.

Natural gas:

A. First estimate NPC, U.S. Energy Outlook: An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 102.

B. Second estimate

NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 10.

Sources for the BOM fuel demand statistics:

1970: Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, Appendix B, Table 11.

1975-1985: Ibid., p. 38.

TABLE D-IV

Electric Utility Energy Demand Projections - Comparisons 1970
(Fuel Units)

	National Petroleum Council PAD Districts						Federal Power Commission	Department of the Interior	Edison Electric Institute-NERA
	I	II	III	IV	V	Total	Total	BOM Total	Total
Petroleum (MB/D)	857	62	10	6	61	996			
Petroleum (mil B/Yr)	285.2	14.3	1.5	2.1	29	332.1	332	333.8	325
Residual (MB/D)	734	27	4	6	78	844			
Distillate (MB/D)	47	16	1		2	66			
Coal (mil T/Yr)							322	322.357	322.2
A. Natural Gas (BCF/Yr)	532	837	1680	48	821	3927	3894	3894.019	3885.8
B. Natural Gas (BCF/Yr)	505	971	1617	63	759	3915			
Hydropower (BKWH)	44.2	30.1	10.8	19	144.9	249	257	252.571	246.943
Geothermal (BKWH)						0.7			
Nuclear (BKWH)						23	22	21.801	21.800
Nuclear (MW(e))						5000	6500		
Total (BKWH)							1534.6		1524.4

Sources are listed at end of table.

TABLE D-IV cont.

Electric Utility Energy Demand Projections - Comparisons 1975
(Fuel Units)

	National Petroleum Council PAD Districts						Federal Power Commission	Department of the Interior BOM	Edison Electric Institute-NERA
	I	II	III	IV	V	Total	Total	Total	Total
Petroleum (MB/D)	1479	113	18	5	82	1697			
Petroleum (mil B/Yr)	540	41	7	2	30	619	565	573	
Residual (MB/D)	1367	75	10	5	80	1537			
Distillate (MB/D)	112	38	8	-	2	160			
Coal (mil T/Yr)						415	425	394	
A. Natural Gas (BCF/Yr)	505	994	2111	55	1018	4684	4110	3686	
B. Natural Gas (BCF/Yr)	566	1448	2298	83	1068	5468			
Hydropower (BKWH)	46	301	12.5	25	157.4	271		350	
Geothermal (BKWH)						12			
Nuclear (BKWH)						326		240	
Nuclear (MW(e))								50,000	
Total (BKWH)								2130	

Sources are listed at end of table.

TABLE D-IV cont.

Electric Utility Energy Demand Projections - Comparisons 1980
(Fuel Units)

	National Petroleum Council PAD Districts						Federal Power Commission	Department of the Interior BOM	Edison Electric Institute-NERA
	I	II	III	IV	V	Total	Total	Total	Total
Petroleum (MB/D)	1891	202	37	5	210	2345			
Petroleum (mil B/Yr)	690	76	14	2	79	855	640	800	375.4
Residual (MB/D)	1725	150	25	5	200	2105			
Distillate (MB/D)	166	57	12	-	10	240			
Coal (mil T/Yr)						525	500	460	441.8
A. Natural Gas (BCF/Yr)	505	1179	2494	66	1107	5351	3800	3492	6072.9
B. Natural Gas (BCF/Yr)	592	1655	2965	95	885	6192			
Hydropower (BKWH)	48.5	29.3	15	31.3	171.9	296		420	341.25
Geothermal (BKWH)						34			
Nuclear (BKWH)						926	874	630	945
Nuclear (MW(e))							140,000	120,000	
Total (BKWH)								3000	3082.46

Sources are listed at end of table.

TABLE D-IV cont.

Electric Utility Energy Demand Projections - Comparisons 1985
(Fuel Units)

	National Petroleum Council PAD Districts						Federal Power Commission	Department of the Interior	Edison Electric Institute-NERA
	I	II	III	IV	V	Total	Total	BOM Total	Total
Petroleum (MB/D)	2073	230	47	5	310	2665			
Petroleum (mil B/Yr)	757	84	17	2	113	972	725	1064	329.7
Residual (MB/D)	1900	175	35	5	300	2415			
Distillate (MB/D)	173	55	17	-	10	250			
Coal (mil T/Yr)						654	600	613	470.8
A. Natural Gas (BCF/Yr)	505	1413	2949	77	1275	6219	3800	3346	6497.8
B. Natural Gas (BCF/Yr)	682	1793	3852	116	829	7272			
Hydropower (BKWH)	50	30	15.5	38	182.5	316		470	460.3
Geothermal (BKWH)						51			
Nuclear (BKWH)						2067		1130	1925
Nuclear (MW(e))								215,000	
Total (BKWH)								4140	4256.485

Sources are listed at end of table.

Sources: TABLE D-IV

Sources for the NPC fuel demand statistics:

Petroleum fuel oils: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 52, 111-112.

Coal (not including short-fall additions): NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 128.

Natural gas:

A. First estimate: Ibid., p. 102.

B. Second estimate: NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 184.

Hydropower: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 184.

Geothermal: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 184.

Nuclear: Ibid.

Source for the FPC fuel demand statistics:

Federal Power Commission, "Guidelines for the Growth of the Electric Power Industry," The 1970 National Power Survey, Part I, U.S. Government Printing Office, Washington, D.C., Dec. 1971, pp. 3-14, 15; 4-2, 18, 19.

Source for the BOM fuel demand statistics:

1975: Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, Appendix B, Table 7.

1975-1985:

1975-1985: Ibid., pp. 26, 28.

Source for the EEI fuel demand statistics:

Fossil fuels: National Economic Research Associates, Inc. Fuels for the Electric Utility Industry 1971-1985, A Report to the Edison Electric Institute, Aug. 1972, pp. 28, 29.

Sources: TABLE D-IV cont.

Hydropower and Nuclear: Ibid., pp. 27, 28.

TABLE E-I

Residential/Commercial Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior--BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
1970							
Petroleum-Fuel & Nonfuel							6453
Petroleum-Fuel	3207	1471	248	105	252	5283	5371
LPG	132	356	176	32	43	738	
Kerosine	228	137	42	8	4	419	
Distillate	1945	829	26	49	138	2988	
Residual	902	149	4	16	77	1138	
Petroleum Nonfuel							1082
Coal						280	427
A. Natural Gas	1877	3349	715	260	1017	7218	7108
B. Natural Gas	1800	3197	734	260	910	6901	
Total Fossil Fuel						12,781	12,906
Total Fossil Fuel (with nonenergy fuel)							13,989
Electricity Purchased							3000
Total							15,906
Total (with nonenergy fuel)							16,989

Sources are listed at end of table.

TABLE E-I cont.

Residential/Commercial Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior--BOM
1975	I	II	III	IV	V	U.S. Totals	U.S. Totals
Petroleum-Fuel & Nonfuel							6950
Petroleum-Fuel	3513	1646	283	124	265	583?	5750
LPG	168	455	205	40	47	915	
Kerosine	210	126	37	6	4	383	
Distillate	2121	882	34	60	145	3242	
Residual	1014	183	7	18	69	1291	
Petroleum Nonfuel							1200
Coal						196	325
A. Natural Gas	2268	3887	800	285	1186	8426	8660
B. Natural Gas	2260	3896	848	310	1125	8439	
Total Fossil Fuel						14,453	14,735
Total Fossil Fuel (with nonenergy fuel)							15,935
Electricity Purchased							4240
Total							18,975
Total (with nonenergy fuel)							20,175

Sources are listed at end of table.

TABLE E-I cont.

Residential/Commercial Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior--BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
1980							
Petroleum-Fuel & Nonfuel							7720
Petroleum-Fuel	3760	1751	327	142	265	6245	6440
LPG	191	498	242	47	50	1028	
Kerosine	194	118	33	4	4	353	
Distillate	2309	927	43	70	147	3496	
Residual	1066	208	9	21	64	1368	
Petroleum Nonfuel							1280
Coal						140	300
A. Natural Gas	2739	4539	920	323	1409	9930	
B. Natural Gas	2723	4597	1011	349	1327	10,007	
Total Fossil Fuel						16,315	16,220
Total Fossil Fuel (with nonenergy fuel)							17,500
Synthetic Gas							320
Electricity Purchased							6040
Total							22,580
Total (with nonenergy uses)							23,860

Sources are listed at end of table.

TABLE E-I cont.

Residential/Commercial Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior--BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
1985							
Petroleum-Fuel & Nonfuel							8800
Petroleum-Fuel	3966	1840	364	166	266	6596	7480
LPG	212	545	271	54	53	1135	
Kerosine	176	109	29	2	4	320	
Distillate	2481	957	53	81	149	3721	
Residual	1097	229	11	23	60	1420	
Petroleum Nonfuel							1320
Coal						84	100
A. Natural Gas	3272	5324	1060	363	1642	11,661	10,060
B. Natural Gas	3242	5403	1182	394	1548	11,769	
Total Fossil Fuel						18,315	17,640
Total Fossil Fuel (with nonenergy fuel)							18,960
Synthetic Gas							940
Electricity Purchased							7800
Total							26,380
Total (with nonenergy uses)							27,700

Sources are listed at end of table.

Sources: Table E-I

Sources for the NPC fuel statistics:

Petroleum fuels: NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 59-64.

Coal: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, p. 127.

Natural gas: A. First estimate: NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, p. 102.

B. Second estimate: NPC, "Gas Demand," U.S. Energy Energy Outlook (Rev.), 1973, p. 10.

Sources for the BOM fuel statistics:

1970: Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, Appendix B, Table 12.

1975-1985: Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, p. 34.

TABLE E-II

Industrial Energy Demand Projections - Comparisons
(10^{15} BTU's)

1970	National Petroleum Council (Intermediate) PAD Districts I	II	III	IV	V	U.S. Totals	Department of the Interior--BOM U.S. Totals
Petroleum-Fuel & Nonfuel						6375	5267
Petroleum-Fuel: Excluding Raw Materials	1066	905	687	123	471	3253	3252
Distillate	175	225	92	31	100	623	
Residual	651	204	28	41	148	1072	
LPG	34	48	16	4	12	114	
Petro Coke	54	90	139	12	33	328	
Still Gas	127	296	363	27	177	990	
Kerosine & Other	25	42	49	8	1	125	
Petroleum-Nonfuel: Raw Materials	616	735	1386	96	286	3119	2015
Lubricants	118	92	47	13	29	299	
Asphalt & Road Oil	285	390	173	70	148	1066	
Wax, Coke & Miscellaneous	49	82	77	8	28	244	
Special Naphtha	45	39	54	2	24	164	
Petrochemical Feedstock							
LPG-Chemical Uses	61	66	650	--	27	804	
Still Gas, Naphtha & Miscellaneous	58	66	385	3	30	542	
Coal						5054	5004
Coking						2688	
Industrial						2366	
Fuel Coal							4853
Nonfuel Coal							151
A. Natural Gas	1302	2526	3832	240	961	8862	10162
Fuel							9475
Nonfuel							687
B. Natural Gas	1284	2478	4140	238	897	9037	
Electricity Purchased							2210
Total (without electricity purchased and coking coal)						17600	
Total (without electricity purchased)						20288	20433
Total NPC Intermediate Projection						17798	

Sources are listed at end of table.

TABLE E-II cont.

Industrial Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior--BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
1975							
Petroleum-Fuel & Nonfuel						8032	6510
Petroleum-Fuel: Excluding Raw Materials	1314	1111	775	165	614	3979	3910
Distillate	193	259	108	41	124	725	
Residual	804	287	40	60	189	1380	
LPG	48	68	24	6	18	164	
Petro Coke	70	103	161	14	46	394	
Still Gas	177	347	385	33	236	1178	
Kerosine & Other	22	47	57	11	1	138	
Petroleum- Nonfuel: Raw Materials	742	933	1887	116	375	4053	2600
Lubricants	130	101	52	15	32	330	
Asphalt & Road Oil	330	510	230	88	199	1357	
Wax, Coke & Miscellaneous	555	91	86	8	35	275	
Special Naphtha	48	42	58	2	26	176	
Petrochemical Feedstock							
LPG-Chemical Uses	98	102	807	--	38	1135	
Still Gas, Naphtha & Miscellaneous	81	87	564	3	45	780	
Coal						5398	4600
Coking						3136	
Industrial						2262	
Fuel Coal							4450
Nonfuel Coal							150
A. Natural Gas	1883	3146	4842	277	1227	11375	11740
Fuel							11040
Nonfuel							700
B. Natural Gas	2071	3699	5284	298	1289	12641	
Electricity Purchased							3010
Total (without electricity purchased and coking coal)						21699	
Total (without electricity purchased)						24805	22850
Total NPC Intermediate Projection						20039	

Sources are listed at end of table.

TABLE E-II cont.

Industrial Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior--BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
1980							
Petroleum-Fuel & Nonfuel						9974	7590
Petroleum-Fuel: Excluding Raw Materials	1640	1376	913	212	721	4862	4410
Distillate	215	292	126	51	141	805	
Residual	946	377	110	81	213	1727	
LPG	73	105	36	9	27	250	
Petro Coke	105	121	169	17	63	475	
Still Gas	276	424	404	40	276	1420	
Kerosine & Other	25	57	68	14	1	165	
Petroleum- Nonfuel: Raw Materials	992	1140	2380	137	463	5112	3180
Lubricants	143	112	58	17	35	365	
Asphalt & Road Oil	400	411	264	106	249	1630	
Wax, Coke & Miscellaneous	60	101	95	8	39	303	
Special Naphtha	52	47	63	3	29	194	
Petrochemical Feedstock							
LPG-Chemical Uses	143	156	1178	--	53	1530	
Still Gas, Naphtha & Miscellaneous	194	113	722	3	58	1090	
Coal						5544	4750
Coking						3360	
Industrial						2184	
Fuel Coal							4550
Nonfuel Coal							200
A. Natural Gas	2329	3846	5722	330	1473	13700	12500
Fuel							11750
Nonfuel							750
B. Natural Gas	2666	4673	6038	327	1457	15161	
Electricity Purchased							4170
Total (without electricity purchased and coking coal)						25858	
Total (without electricity purchased)						29218	24840
Total NPC Intermediate Projection						22341	

Sources are listed at end of table.

TABLE E-II cont.

Industrial Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior--BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
1985							
Petroleum-Fuel & Nonfuel						12116	9130
Petroleum-Fuel: Excluding Raw Materials	2012	1593	1046	261	841	5753	5600
Distillate	239	335	145	61	170	950	
Residual	1040	440	141	101	231	1953	
LPG	105	145	50	13	37	350	
Petro Coke	165	138	175	20	77	575	
Still Gas	435	467	450	48	325	1725	
Kerosine & Other	28	68	85	18	1	200	
Petroleum-Nonfuel: Raw Materials	1267	1370	2997	164	565	6363	3530
Lubricants	159	124	64	21	37	405	
Asphalt & Road Oil	478	721	315	127	309	1950	
Wax, Coke & Miscellaneous	67	111	104	9	44	335	
Special Naphtha	59	51	69	3	31	213	
Petrochemical Feedstock							
LPG-Chemical Uses	210	216	1492	--	72	1090	
Still Gas, Naphtha & Miscellaneous	**294**	**147**	**953**	**4**	**72**	**1470**	
Coal						5608	5150
Coking						3528	
Industrial						2080	
Fuel Coal							4820
Nonfuel Coal							330
A. Natural Gas	2884	4713	6765	386	1719	16467	13240
Fuel							12440
Nonfuel							800
B. Natural Gas	3340	5606	6872	361	1626	17805	
Electricity Purchased							6290
Total (without electricity purchased and coking coal)						30663	
Total (without electricity purchased)						34191	27520
Total NPC Intermediate Projection						24667	

Sources are listed at end of table.

Sources: TABLE E-II

Sources for the NPC fuel demand statistics:

Petroleum fuel oils:	NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 67-68.
	LPG is industrial and utility is gas demand. Petro Coke is a nonmerchantable product demand. Wax, Coke & Miscellaneous does not include nonmerchantable coke.
Coal:	NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 127.
Natural gas:	
A. First estimate	Ibid., p. 102
B. Second estimate	NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 10.

Source for the BOM fuel demand statistics:

1970:	Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, Appendix B, Table 9.
1975-1985:	Ibid., p. 40.

Synthetic gas estimates for selected years:

1980	380	10^{12} BTU's
1985	1060	10^{12} BTU's

TABLE E-III

Transportation Energy Demand Projections - Comparisons
(10^{15} BTU's)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior - BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
1970							
Petroleum						15,314	15,592
Motor Gasoline						11,084	
Aviation Gasoline						101	
Naphtha Jet						478	
Kerosine Jet						1,490	
Distillate-Vessel						111	
Distillate-Railroad						495	
Distillate-Highway						827	
Kerosine-Highway							
LPG & LNG Internal Combustion Fuels						156	
Residual Bunker Fuel Oil						572	
5,800 MBTU's Crude Bbl Equivalent						16,594	
NPC Energy Tables Revised						16,234	
A. Natural Gas	61	233	271	9	55	629	745
B. Natural Gas	65	252	305	10	57	689	
Total Fossil Fuel						16,863	16,345
Electricity Purchased							16
Total							16,361

Sources are listed at end of table.

TABLE E-III cont.

Transportation Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior - BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
1975							
Petroleum						18,886	18,050
Motor Gasoline						13,313	
Aviation Gasoline						88	
Naphtha Jet						431	
Kerosine Jet						2415	
Distillate-Vessel						122	
Distillate-Railroad						577	
Distillate-Highway						1089	
Kerosine-Highway						23	
LPG & LNG Internal Combustion Fuels						206	
Residual Bunker Fuel Oil						622	
5,800 MBTU's Crude Bbl Equivalent						20,423	
NPC Energy Tables Revised						19,852	
A. Natural Gas	84	308	369	11	75	847	1020
B. Natural Gas	88	342	393	12	74	909	
Total Fossil Fuel						20,699	19,070
Electricity Purchased							20
Total							19,090

Sources are listed at end of table.

TABLE E-III cont.

Transportation Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior - BOM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
1980							
Petroleum						22,992	21,440
Motor Gasoline						15,750	
Aviation Gasoline						116	
Naphtha Jet						413	
Kerosine Jet						3,625	
Distillate-Vessel						128	
Distillate-Railroad						669	
Distillate-Highway						1,416	
Kerosine-Highway						73	
LPG & LNG Internal Combustion Fuels						132	
Residual Bunker Fuel Oil						670	
5,800 MBTU's Crude Bbl Equivalent						24,926	
NPC Energy Tables Revised						23,772	
A. Natural Gas	101	365	460	13	86	1,025	1,400
B. Natural Gas	107	411	465	14	80	1,077	
Total Fossil Fuel						24,797	22,840
Electricity Purchased							30
Total							22,870

Sources are listed at end of table.

TABLE E-III cont.

Transportation Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council (Intermediate) PAD Districts						Department of the Interior - BCM
	I	II	III	IV	V	U.S. Totals	U.S. Totals
1985							
Petroleum						27,074	25,450
Motor Gasoline						17,623	
Aviation Gasoline						156	
Naphtha Jet						392	
Kerosine Jet						4,973	
Distillate-Vessel						140	
Distillate-Railroad						774	
Distillate-Highway						1,610	
Kerosine-Highway						279	
LPG & LNG Internal Combustion Fuels						411	
Residual Bunker Fuel Oil						716	
5,800 MBTU's Crude Bbl Equivalent						29,217	
NPC Energy Tables Revised						28,160	
A. Natural Gas	120	435	510	15	100	1,180	1,640
B. Natural Gas	130	480	551	16	87	1,264	
Total Fossil Fuel						29,340	27,090
Electricity Purchased							40
Total							27,130

Sources are listed at end of table.

Source: TABLE E-III

Sources for the NPC fuel demand statistics:

Petroleum fuel oils:	NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. 88.
Natural gas:	
A. First estimate	NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 102.
B. Second estimate	NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 10.

Source for the BOM fuel demand statistics:

1970:	Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, Appendix B, Table 11.
1975-1985:	Ibid., p. 38.

TABLE E-IV

Electric Utility Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council						Bureau of Mines Dept. of the Interior	Federal Power Commission
	PAD Districts							
	I	II	III	IV	V	U.S. Totals	U.S. Totals	U.S. Totals
1970								
Petroleum	1793	90	10	13	182	2088	2087	2070
Residual	1685	50	9	14	179	1937		
Distillate	100	34	2	-	4	140		
Coal						7728	7483	7505
A. Natural	548	863	1732	49	857	4049	4015	4042
B. Natural Gas	505	971	1617	63	759	3915		
Total Fossil Fuel Demand						13865	13585	13617
Nuclear	147	32	-	-	63	242	299	
Hydro	475	324	116	204	1558	2677	2650	
Geothermal						7		
Total Demand						16791	16464	

Sources are listed at end of table.

TABLE E-IV cont.

Electric Utility Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council						Bureau of Mines Dept. of the Interior	Federal Power Commission
	PAD Districts							
	I	II	III	IV	V	U.S. Totals	U.S. Totals	U.S. Totals
1975								
Petroleum						3867	3580	3530
Residual	3137	172	23	11	184	3527		
Distillate	238	81	17	-	4	340		
Coal						9960	8900	9902
A. Natural	521	1025	2176	57	1050	4829	3800	4255
B. Natural Gas	566	1448	2298	83	1068	5463		
Total Fossil Fuel Demand						18823	16280	17687
Nuclear	1691	1076	287	21	267	3342	2560	
Hydro	482	315	131	262	1650	2840	3570	
Geothermal						120		
Total Demand						25125	22970	

Sources are listed at end of table.

TABLE E-IV cont.

Electric Utility Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council						Bureau of Mines Dept. of the Interior	Federal Power Commission
	PAD Districts							
1980	I	II	III	IV	V	U.S. Totals	U.S. Totals	U.S. Totals
Petroleum						5354	5000	4000
Residual	3970	345	57	11	460	4843		
Distillate	353	111	26	-	21	511		
Coal						12600	10660	11600
A. Natural	521	1216	2571	68	1141	5517	3600	3932
B. Natural Gas	597	1655	2965	95	885	6192		
Total Fossil Fuel Demand						23594	19260	19532
Nuclear	4490	2880	861	31	1230	9492	6720	
Hydro	497	300	154	321	1761	3033	3990	
Geothermal						343		
Total Demand						36339	29970	

Sources are listed at end of table.

TABLE E-IV cont.

Electric Utility Energy Demand Projections - Comparisons
(10^{12} BTU's)

	National Petroleum Council						Bureau of Mines Dept. of the Interior	Federal Power Commission
	PAD Districts							
	I	II	III	IV	V	U.S. Totals	U.S. Totals	U.S. Totals
1985								
Petroleum	4728	519	106	11	710	6074	6650	4532
Residual	4360	402	80	11	689	5542		
Distillate	368	117	26	-	21	532		
Coal						15696	14220	13860
A. Natural	521	1457	3040	79	1315	6412	3450	3932
B. Natural Gas	682	1793	3852	116	829	7272		
Total Fossil Fuel Demand						28182	24320	22325
Nuclear	9953	5822	2255	82	3075	21187	11750	
Hydro	494	296	153	375	1800	3118	4320	
Geothermal						514		
Total Demand						53001	40390	

Sources are listed at end of table.

Sources: TABLE E-IV

Sources for the NPC fuel demand statistics:

Petroleum fuel oils:	NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, pp. 101-112.
Coal:	NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 127.
Natural gas:	
A. First estimate	Ibid., p. 102.
B. Second estimate	NPC, "Gas Demand," U.S. Energy Outlook (Rev.), 1973, p. 149.
Nuclear:	NPC, U.S. Energy Outlook: An Initial Appraisal 1971-1985, vol. 2, Nov. 1971, p. 149.
Hydropower:	Ibid., p. 185.
Geothermal:	NPC, Oil Subcommittee, "An Initial Appraisal by the Oil Demand Task Group 1971-1985," U.S. Energy Outlook: An Interim Report, 1972, p. xxiii.
Total demand:	National Petroleum Council, U.S. Energy Outlook, Dec. 1972, p. 37.

Sources for the BOM fuel demand statistics:

1970:	Department of the Interior, Bureau of Mines, United States Energy Through the Year 2000, Dec. 1972, Appendix B, Table 7.
1975-1985:	Ibid., p. 26.

Source for the FPC fuel demand statistics:

Federal Power Commission, "Guidelines for the Growth of the Electric Power Industry", The 1970 National Power Survey, Part I, U.S. Government Printing Office, Washington, D.C., 1971, p. 4-2.

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17. Key Words and Document Analysis. 17a. Descriptors

Coal
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Natural Gas
Hydropower
Nuclear

PAD Districts
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Industrial
Transportation
Electric Utility
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